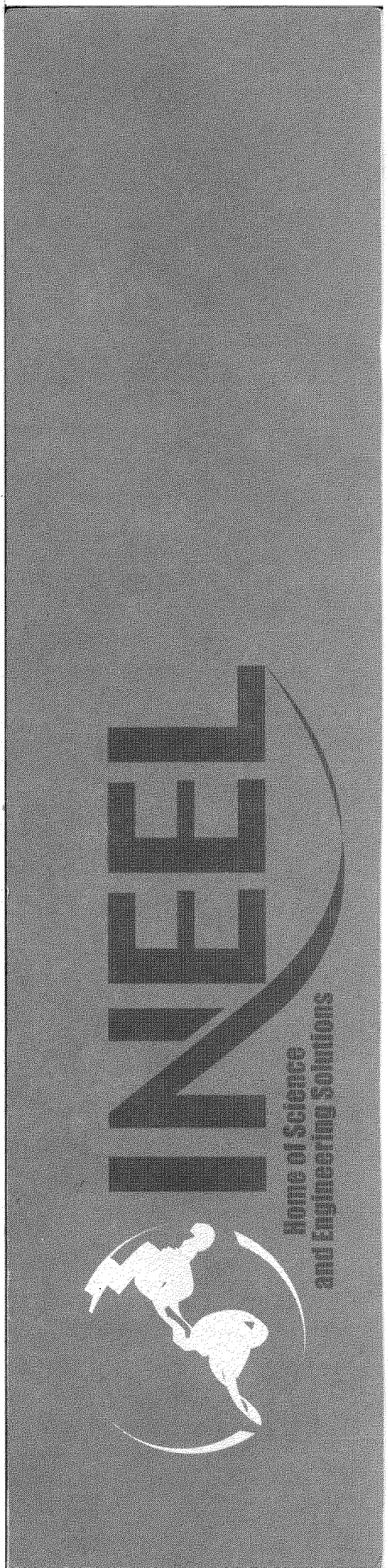
INEEL/EXT-03-00628
Revision 0

Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1-3 (Phase I) Health and Safety Plan



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January 2004

Idaho Completion Project
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE/NE Idaho Operations Office
Contract DE-AC07-99ID13727

ABSTRACT

This Health and Safety Plan establishes the procedures and requirements used to eliminate or minimize health and safety risks to personnel working at the Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1-3 (Phase I) site, as required by the Occupational Safety and Health Administration standard, "Hazardous waste operations and emergency response," 29 CFR 1910.120 and 29 CFR 1926.65. It contains information about the hazards involved in performing the work as well as the specific actions and equipment that will be used to protect personnel while working at the work site.

This Health and Safety Plan is intended to give safety and health professionals the flexibility to establish and modify site safety and health procedures throughout the entire span of site operations based on the existing and anticipated hazards. The health and safety officer supporting these activities will determine the most appropriate hazard control and required mitigation measures based on site-specific conditions and will make changes to this document as appropriate.

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
anti-C	anticontamination
APF	assigned protection factor
BBWI	Bechtel BWXT Idaho, LLC
BLM	Bureau of Land Management
CAM	continuous air monitor
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Central Facilities Area
CNS	central nervous system
COC	contaminant of concern
COPC	contaminant of potential concern
CRC	contamination reduction corridor
CRZ	contamination reduction zone
CWA	Clean Water Act
DAC	derived air concentration
DAR	Document Action Request
dBA	decibel A-weighted
DOE	Department of Energy
DOT	Department of Transportation
DWA	designated work area
EAM	emergency action manager
EDF	Engineering Design File
EPA	Environmental Protection Agency

ER	environmental restoration
ERO	Emergency Response Organization
ES&H	environment, safety, and health
FSP	field sampling plan
FTL	field team leader
GFCI	ground fault circuit interrupter
GI	gastrointestinal
GM	Geiger-Mueller counter
HASP	health and safety plan
HAZMAT	hazardous material
HAZWOPER	hazardous waste operations and emergency response
HEPA	high-efficiency particulate air
HLLW	high-level liquid waste
HSO	health and safety officer
ICDF	INEEL CERCLA Disposal Facility
ICP	Idaho Completion Project
IDEQ	Idaho Department of Environmental Quality
IDLH	immediately dangerous to life or health
IH	industrial hygiene
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISMS	Integrated Safety Management System
JSA	job safety analysis
MCP	management control procedure
NE-ID	Department of Energy Idaho Operations Office
NEPA	National Environmental Policy Act of 1969

NIOSH	National Institute for Occupational Safety and Health
NWCF	New Waste Calcining Facility
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCM	personnel contamination monitor
PEL	permissible exposure limit
PEP	project execution plan
PEW	Process Equipment Waste
PID	photoionization detector
PMP	project management plan
PMT	Program Management Team
POD	plan of the day
PPE	personal protective equipment
PRD	program requirements document
RadCon	Radiological Control
RAM	radiation area monitor
RBA	Radiological Buffer Area
RCIMS	Radiological Control Information Management System
RCT	radiological control technician
RD/RA	remedial design/remedial action
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RG	Regulatory Guide
RMA	Radioactive Material(s) Area
ROD	Record of Decision

RW	radioactive waste
RWMC	Radioactive Waste Management Complex
RWP	radiological work permit
SAD	site area director
SAP	sampling and analysis plan
SCBA	self-contained breathing apparatus
SDA	Subsurface Disposal Area
SH&QA	safety, health, and quality assurance
SME	subject-matter expert
SNF	spent nuclear fuel
SSA	Staging and Storage Annex
STEL	short-term exposure limit
STP	Sewage Treatment Plant
STR	subcontract technical representation
SWP	safe work permit
TFR	technical and functional requirement
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TPR	technical procedure
TRAIN	Training Records and Information Network
TRU	transuranic
TWA	time-weighted average
UV	ultraviolet
VD	vapor density
VOC	volatile organic compound
VPP	Voluntary Protection Program

WAC	Waste Acceptance Criteria
WAG	waste area group
WCC	Warning Communications Center
WCF	Waste Calcining Facility
WMP	waste management plan

Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1-3 (Phase I) Health and Safety Plan

1. INTRODUCTION

This Health and Safety Plan (HASP) establishes the procedures and requirements used to eliminate or minimize health and safety hazards to personnel working at the Operable Unit (OU) 3-13, Group 3, Other Surface Soils Remediation Phase I sites at the Idaho National Engineering and Environmental Laboratory (INEEL). The location of the INEEL within the State of Idaho is shown in Figure 1-1.

1.1 Scope and Objectives

This HASP has been written to meet the requirements of the Occupational Safety and Health Administration (OSHA) standard, "Hazardous waste operations and emergency response (HAZWOPER)," 29 CFR 1910.120 and 29 CFR 1926.65. This HASP governs all work at OU 3-13, Group 3, sites performed by Clean/Close Idaho Nuclear Technology and Engineering Center (INTEC) which is part of the Idaho Completion Project (ICP) management and operations contractor personnel, subcontractors, and any other personnel who enter the project area.

Note: Subcontractors are required to follow the Subcontractor Requirements Manual (TOC-59) and the applicable program requirements documents (PRDs) specified in this HASP. While working on the project, ICP personnel are subject to the management control procedures (MCPs) and applicable PRDs specified in this HASP.

This HASP has been reviewed and revised as deemed appropriate by the Clean Close INTEC, Subproject 6, health and safety officer (HSO) in conjunction with other project personnel and management to ensure its effectiveness and suitability.

1.2 Idaho National Engineering and Environmental Laboratory Site Description

The INEEL, formerly the National Reactor Testing Station, encompasses 569,135 acres (889 mi^2) and is located approximately 55 km (34 mi) west of Idaho Falls, Idaho. The U.S. Department of Energy Idaho Operations Office (NE-ID)[a] has responsibility for the INEEL and designates authority to operate the INEEL to government management and operating contractors.

The United States Atomic Energy Commission, now the U.S. Department of Energy (DOE), established the National Reactor Testing Station (now the INEEL) in 1949 as a site for building and testing a variety of nuclear facilities. The INEEL also has been the storage facility for transuranic radionuclides and radioactive low-level waste since 1952. At present, the INEEL supports the engineering and operations efforts of DOE and other federal agencies in areas of nuclear safety

a. NE-ID signifies that the DOE Idaho Operations Office reports to the DOE Office of Nuclear Energy, Science, and Technology (NE).

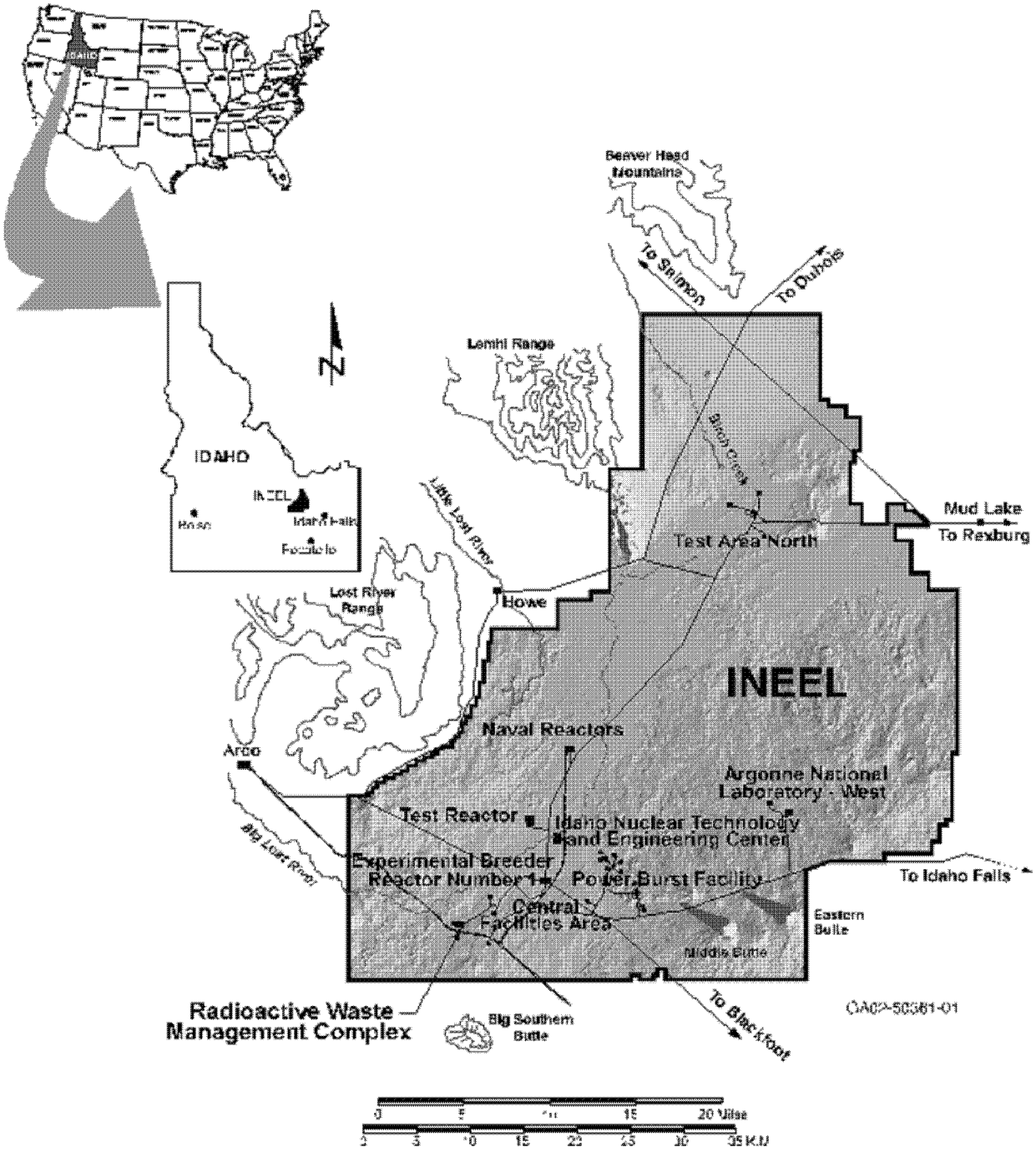

Figure 1-1. Map of the Idaho National Engineering and Environmental Laboratory Site.

research, reactor development, reactor operations and training, nuclear defense materials production, waste management technology development, energy technology and conservation programs, and DOE long-term stewardship programs.

1.3 Background and Project Site Description

INTEC is located in the south-central portion of the INEEL (Figure 1-1). It is one of the facilities at the INEEL primarily dedicated to nuclear research, nuclear development, and waste management. Surrounding areas are for multipurpose use and are managed by the U.S. Bureau of Land Management (BLM). The developed area within the INEEL is surrounded by a 1,295-km^2 (500-mi^2) buffer zone used for cattle and sheep grazing. Communities nearest to the INTEC are Atomic City (south), Arco (west), Butte City (west), Howe (northwest), Mud Lake (northeast), and Terreton (northeast). In the counties surrounding the INEEL, approximately 45% is agricultural land, 45% is open land, and 10% is urban. Sheep, cattle, hogs, poultry, and dairy cattle are produced; and potatoes, sugar beets, wheat, barley, oats, forage, and seed crops are cultivated. Private individuals or the U.S. Government own most of the land surrounding the INEEL.

Public access to the INEEL is strictly controlled by fences and security personnel. State Highways 22, 28, and 33 cross the northeastern portion of the INEEL approximately 32.2 km (20 mi) from INTEC, and U.S. Highways 20 and 26 cross the southern portion approximately 8 km (5 mi) from INTEC. A total of 145 km (90 mi) of paved highways pass through the INEEL and are used by the general public.

The INTEC began operating in 1952. The primary missions were to reprocess uranium for defense purposes and to research and store spent nuclear fuel (SNF). Irradiated defense nuclear fuels were reprocessed to recover unused uranium. In 1992, the reprocessing mission was phased out. The current INTEC mission is to receive and temporarily store SNF and radioactive wastes for future disposition.

In addition to reprocessing SNF, INTEC stabilized high-level liquid waste (HLLW) from fuel reprocessing through a process known as calcination. That processing was conducted in a facility known as the Waste Calcining Facility (WCF) where radioactive HLLW was converted into a granular solid similar in consistency to sand. The liquid waste was drawn from underground storage tanks at the tank farm and sprayed into a vessel superheated by a mixture of kerosene and oxygen. Most of the liquid would evaporate, while radioactive fission products adhered to the granular bed material in the vessel. The off-gases were treated and monitored before they were released to the environment. The calcined solids were transferred to large stainless steel structures encased in thick concrete vaults (bin sets). Calcining achieve an eight-to-one volume reduction from liquid to solid. Although processing of nuclear fuel was terminated in 1992, calcination of the HLLW continued until it was completed in February 1998. Sodium-bearing wastes are still being processed. The WCF was replaced in 1982 by another similar unit, the New Waste Calcining Facility (NWCF).

Releases of radioactive and hazardous materials to the environment have occurred over the past decades due to accidents and intentional operational releases, such as discharge of radionuclide-contaminated wastewater beneath the INTEC via the former injection well. Although these operational releases fail to meet contemporary standards, past intentional discharges did meet rules and standards of the time.

To better manage environmental investigations, the INEEL was divided into 10 waste area groups (WAGs). Identified contaminant release sites in each WAG were grouped into OUs to expedite the investigations and any required remedial actions. The INTEC was designated as WAG 3 and was subdivided into 13 OUs that were investigated for contaminant releases to environmental pathways. Fifty-five (55) WAG 3 (OU 3-13) sites were identified as posing a potential carcinogenic risk greater than 1×10^{-4} or threat to human health and/or the environment. These sites require remedial action to mitigate these risks or threats. Ten (10) of the 55 sites were included in OU 3-13, Group 3, Other Surface Soils Remediation Sets 1-3, Phase I sites.

1.4 Scope of Work

The Other Surface Soils release sites contain wastes with the potential to expose workers, the environment, and the public to radionuclide-contaminated soils. Exposure to radionuclides at these sites must be minimized to allow these sites to be released for unrestricted use in the future. The selected remedy for Other Surface Soils is removal and on-Site disposal in the INEEL CERCLA Disposal Facility (ICDF).

For Cs-137, contaminated soils will be cleaned up to below 23 pCi/g, for the future residential use scenario. The background Cs-137 activity is approximately 1 pCi/g, which is equivalent to a 10^{-5} excess carcinogenic risk. The acceptable risk for cleanup to future residential standards for Cs-137 is 1×10^{-4} by the year 2095. "No Further Action" sites that represent a threat if land use was residential but do not represent a threat under an industrial land use scenario.

Contaminated soil and debris from Group 3 sites will be removed using the following conventional excavation methods:

1. Remove contaminated soils and debris above the 1×10^{-4} (23-pCi/g) risk level based on an assumed future residential use in the year 2095 and beyond, and replace with clean soil so that, from the surface to a depth of 3 m (10 ft), the land can be released for future residential use. Contamination below 3 m (10 ft) may also be excavated at the discretion of the DOE, if determined to be more cost effective than maintaining necessary institutional controls to prevent future drilling through deep contamination zones and transportation of contaminants to the underlying aquifer. In addition, excavation activities below the 3 m (10 ft) depth that could cause the movement of contaminants either to the surface or to the underlying aquifer will be controlled.

2. Transport contaminated soils and debris to the ICDF for disposal. The ICDF is located within the WAG 3 area of contamination.

3. Survey and record contamination left in place at depths below 3 m (10 ft) for future institutional controls, as necessary.

4. Replace excavated soils with clean backfill and re-grade.

1.4.1 Remediation Sites

This remediation project will be completed in two phases. The Phase I, Group 3, soil sites at INTEC appear as green shaded areas in Figure 1-2. This HASP addresses only the sites included in Remediation Sets 1, 2, and 3, which will be completed under Phase I. The remaining sites in Sets 4, 5, and 6 will be completed later under Phase II.

1.4.1.1 Remediation Set 1.

CPP-97—Located in the northeast corner of INTEC, this site consists of two tarp-covered soil stockpiles that originated in the tank farm area and the adjacent surface soils around the stockpiles. The southern boundary of the site is Palm Avenue, the northern boundary is Chestnut Avenue, and the eastern boundary is Lodge Pole Street.

The stockpiles were generated during the 1993 to 1995 HLLW tank farm upgrade project during which several areas of the tank farm were excavated. The soils were monitored for radionuclides during

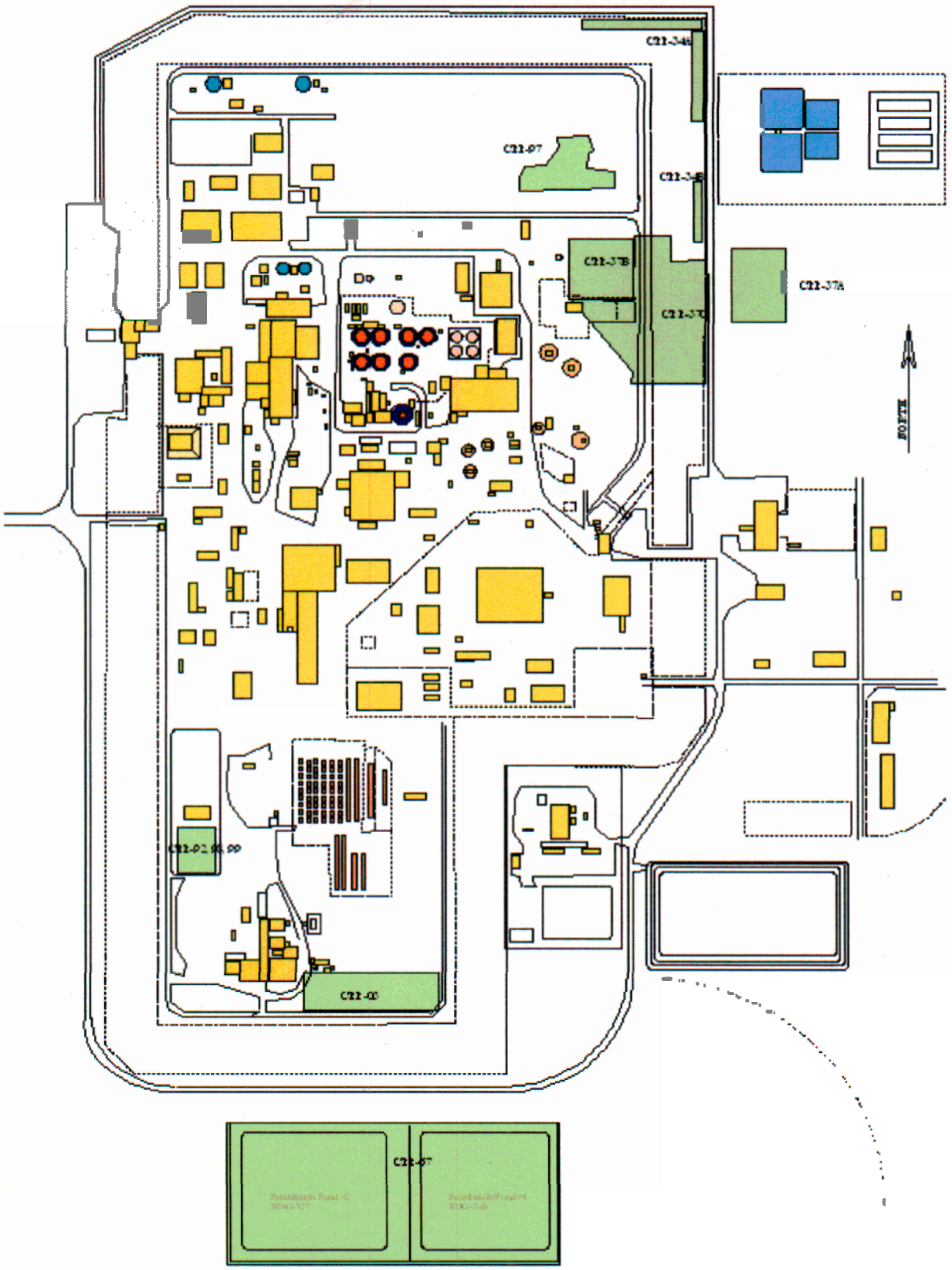

Figure 1-2. Map of the Group 3, Other Surface Soils sites, at INTEC.

excavation. Based on the activity concentration, the soils were segregated into separate piles. The contact readings on the larger 1,090-m^3 (1,430-yd^3) stockpile were 0 to 3 milliroentgen-equivalent man per hour (mrem/hr). The contact readings on the smaller 53-m^3 (70-yd^3) stockpile were 3 to 50 mrem/hr. Additional 3- to 50-mrem/hr soils were placed in 0.6- × 1.2- × 2.4-m (2- × 4- × 8-ft) boxes and transported to the WAG 3 Staging and Storage Annex (CPP-1789).

Potential contaminants contained in the stockpiled soils include radionuclides and suspected listed wastes. Contaminant concentrations are expected to be similar to those found in the CPP-89 and CPP-92 soils.

CPP-92—This site consists of a group of 53 soil boxes west of CPP-1617 containing soil and debris contaminated with low levels of radioactive materials. The 0.6- × 1.2- × 2.4-m (2- × 4- × 8-ft) and 1.2- × 1.2- × 2.4-m (4- × 4- × 8-ft) boxes are constructed of 1.9-cm (0.75-in.) plywood lined with a polyethylene membrane. The soils were generated during various INTEC activities, including the tank farm upgrade, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remediation projects, the CPP-603 cleanup, and excavations at INTEC where soil contamination was encountered. Most of the boxes contain soil with such low levels of contamination that the Radioactive Waste Management Complex (RWMC) will not accept the waste for disposal.

Boxed soil from the excavation for the fire exit from Building CPP-604/605 was sampled and analyzed for inorganics, VOCs, and radionuclides. The contaminants of potential concern (COPCs) identified from contaminant screening for the various excavation activities included arsenic, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, Sb-125, U-234, and U-235. Volatile organics were not detected in the samples. The only inorganics detected above background were arsenic at 5.9 mg/kg and mercury at 10.4 mg/kg. Mercury was below the U.S. Environmental Protection Agency (EPA) Region III risk-based soil concentrations of 23 mg/kg residential, noncarcinogenic soil screening level. These contaminations are consistent with the types of contaminants contained in the service wastes and condensates from the Process Equipment Waste (PEW) evaporator that have historically included nitric acid, mercury, plutonium, cesium-137, and strontium.

The soil and debris are contained in polyethylene-lined boxes that have not deteriorated. Therefore, it is assumed that significant amounts of contaminated soil have not leaked from the boxes and that lateral and vertical contaminant migration from the box staging area has not occurred. Assuming that the boxes are 80% full, there is a total of approximately 1,000 m^3 (1,300 yd^3) of soil in the boxes.

CPP-99—This site consists of soil in fifty-eight, 0.6- × 1.2- × 2.4-m (2- × 4- × 8-ft) wooden boxes. The soils were generated during the 1993 to 1995 HLLW tank farm upgrade project. In addition, some boxes contain soils generated during the CPP-605 Egress Tunnel project. Several factors contributed to contamination of the soils, including the following:

- Accidental releases and leaks through INTEC process piping beneath CPP-605 and the tank farm
- Cross contamination through tank farm operational and maintenance excavations
- Fallout from years of operating the INTEC main stack
- Migration of contamination from INTEC tank farm valve boxes and vault stumps via vent tubes prior to 1970
- Windblown contamination from releases outside the tank farm.

The boxed soils were generated and managed as low-level radioactive waste from 1993 through 1995. However, the tank farm and CPP-604 facilities have listed waste codes associated with each area. Therefore, the boxes of soil may contain radioactive and potentially listed constituents and are managed as such.

CPP-98—Wood and metal shoring material from the 1993 to 1995 HLLW tank farm upgrade project are stored in one hundred nineteen, 1.2- × 1.2- × 2.4-m (4- × 4- × 8-ft) and 0.6- × 1.2- × 2.4-m (2- × 4- × 8-ft) wooden boxes. The upgrade project generated and managed the boxes of shoring material as low-level radioactive waste. However, the tank farm area soil contains radioactive and potentially listed constituents. Therefore, the boxes of shoring material are assumed to contain radioactive and listed constituents.

1.4.1.2 Remediation Set 2.

CPP-37B—This gravel pit and debris landfill inside the INTEC security fence measures approximately 79 m (260 ft) × 116 m (380 ft) × 7.9 m (26 ft) with an area estimated at 9,179 m^2 (98,800 ft^2). Prior to 1982, this pit was often used to dispose of waters released from the sludge dewatering pit of the old Sewage Treatment Plant (STP) (CPP-715). After 1982, the pit was used to dispose of construction debris, some of which may have been contaminated with radionuclides. Anecdotal information suggests that the pit may also have been used for disposal of chemical wastes. The year the pit was backfilled is unknown. Modeling and sampling of the site indicated the pit is not a significant contributor to groundwater risk or surface exposure risk. However, since the pit was used as a landfill, characterization is considered insufficient to recommend no further action.

CPP-37C—An area with radioactively contaminated debris was discovered southeast of CPP-37B during excavation to install a culvert for the OU 3-13 Group 1 Tank Farm Interim Action between November 20 and 27, 2000. The culvert was installed along the east perimeter road between two INTEC fences. Debris consisting of lava rock, gravel, and soil with minor quantities of concrete, plywood, pipe, and plastic was found southeast of CPP-37B just inside the outer fence at a beginning depth (bottom of the excavation) of 1.5 to 1.8 m (5 to 6 ft). The debris occupies an excavation that is approximately 10.7 m (35 ft) × 110 m (360 ft) × 4.3 m (14 ft). The debris is most prevalent along the west edge of the trench. While the extent of the debris is not definitively known, it is suspected that it extends to the west, based upon the observed concentration of debris along the west edge of the trench.

Radiological contamination was found on some of the materials that had been removed from the excavation. This contamination ranged from 35,000 disintegrations per minute (dpm) fixed beta-gamma to a maximum of 100,000 dpm fixed beta-gamma contamination. The COPCs associated with this site include the radionuclides associated with the construction debris. This site is similar to CPP-37B in that it was used to dispose of material such as excess soil, concrete, basalt boulders, and piping removed or generated during construction activities in preparation for INTEC infrastructure projects. The contaminants are expected to be similar to those found at CPP-37B.

1.4.1.3 Remediation Set 3.

CPP-03—This temporary storage area southeast of CPP-603 was used to store radioactively contaminated old and abandoned equipment. When the area was decommissioned in the later 1970s, all stored material was boxed and sent to the RWMC for disposal, and the area covered with 28 cm (11 in.) of "cold" soil. Subsequently, 9,175 m^3 (12,000 yd^3) of contaminated soil excavated from the tank farm was stockpiled at the site before burial in three trenches located at the northeast corner of INTEC.

Radiological field surveys in the area indicated surface activity levels above background at various locations at the site. Samples were collected and submitted for radionuclide analyses. The results indicated the primary contaminants of concern were Cs-137 and Sr-90, which were detected from the surface to about 1.2 m (4 ft). The estimated extent of the contamination is 6,970 m^2 (75,000 ft^2) with an estimated volume of 4,600 m^3 (6,000 yd^3).

CPP-37A—Gravel Pit (#1) outside the INTEC security fence measures approximately 43 m (140 ft) × 64 m (210 ft) × 4.3 m (14 ft) deep. Information about early usage is not available; however, the pit was used as a decontamination area of radionuclide-contaminated construction equipment during July and August 1983. During 1982 and 1983 the pit was used as a percolation pond for INTEC service wastewater while refit of the injection well was completed. Currently, Pit #1 receives stormwater runoff from INTEC.

Based on contaminant screening completed in 1991, identified contaminants of primary concern were arsenic, Co-60, Am-241, Cs-137, Np-237, Pu-238, Sr-90, U-235, and U-238. Note that arsenic was detected above the background level of 5.8 mg/kg in eight out of the 14 samples collected. The maximum concentration detected was 8.7 mg/kg.

The radionuclide contamination zone in Pit #1 is assumed to extend from 0 to 3 m (0 to 10 ft) over the 2,731-m^2 (29,400-ft^2) area of the pit.

CPP-67—Unlined percolation Ponds 1 and 2 receive service wastewater consisting primarily of cooling water and condensed steam generated by various INTEC operations. The wastewater is monitored before being discharged to either pond. Measured radioactivity in the wastewater ranges from zero to only a trace. The ponds are fenced to exclude large wildlife entry and unauthorized personnel.

Pond 1, established in 1984, is located southeast of CPP-603, outside the south INTEC security fence. The pond is approximately 125 m (410 ft) in the east-west direction, 146.3 m (480 ft) in the north-south direction, and about 5.5 m (18 ft) deep. The pond was excavated in gravelly alluvium that is approximately 7.6 to 9.1 m (25 to 30 ft) thick and is underlaid by basalt, which locally outcrops in the pond.

Pond 2, adjacent to Pond 1, was established in 1985 after it became apparent the Pond 1 infiltration capacity had decreased and water levels began to rise. Pond 2, at the toe of its slope, is about 154.2 m (500 ft) square and 3 to 4 m (12 to 14 ft) deep. The pond was excavated in gravelly alluvium that is approximately 6 to 11 m (20 to 35 ft) thick and is underlaid by basalt, which locally outcrops in one corner of the pond. The pond was designed to accommodate continuous wastewater flows around 11.4 M L (3 M gal) per day.

A Resource Conservation and Recovery Act (RCRA) clean-closure equivalency was achieved for metals contamination in Pond 1 in April 1994 and in Pond 2 in May 1995; therefore, only radionuclide contamination was assessed as part of the WAG 3 remedial investigation/baseline risk assessment. Based on the investigative results, the zone of contamination for Pond 1 is estimated to be about 1.8 m (6 ft) thick and extends from the surface to 1.8 m (6 ft) below ground surface. The volume of contaminated soil, using the Pond 1 dimensions, beneath the pond was estimated to be 14,500 m^3 (19,000 yd^3).

The zone of contamination for Pond 2 is assumed to be 1.8 m (6 ft) thick and extends from the surface to 1.8 m (6 ft) below ground surface. The volume of contaminated soil beneath the pond, using the Pond 2 dimensions, was estimated to be 8,400 m^3 (11,000 yd^3).

CPP-34A/B—This site consists of soil storage areas (disposal trenches) in the northeast corner of INTEC covering 4,366 m^2 (47,000 ft^2). In 1984, radionuclide-contaminated soil at levels up to 30 mR/hr were removed from a pile east of CPP-603 and disposed of in the trench. The soil was originally excavated from Site CPP-33. Contaminants consist of nitric acid and radionuclides, including Cs-137, U-234, U-238, Np-237, Sr-90, and Pu-238.

Based on investigative results, the primary contaminants of concern are Cs-137 and Sr-90 with average concentrations of 396 pCi/g and 813 pCi/g, respectively. The zone of contamination assumed for this site is from 0 to 61 m (0 to 20 ft) with an estimated volume of 46,600 m^3 (61,000 yd^3). An average width of the trench (10.7 m [35 ft]) was used to calculate soil volumes, as the width of the trench varied from 7.6 to 13.7 m (25 to 45 ft).

1.4.2 Work Steps for Site Excavation

The OU 3-13 site area excavation, waste removal, mass backfill, final grading and contouring, and final site restoration or revegetation operations are sequenced in Steps 1 through 12 as outlined below. These sequencing steps are subject to change based upon the detailed sequencing submitted by the subcontractor performing the work. Estimated soil quantities for mass excavation backfill and recontouring activities are included on the design drawings. Steps are as follows:

- Step 1—Site Mobilization
- Step 2—Establishment of Perimeter Fencing and Site Boundary
- Step 3—Establishment of Decontamination Areas and Systems
- Step 4—Location and Isolation of Utilities
- Step 5—Mass Excavation
- Step 5a—Excavation of OU 3-13 Site Area Limits to Design Depths or 10 ft 0 in. bgs
- Step 5b—Iterative Excavation and Soil Screening to Meet Regulatory Guides (RGs) or 10 ft 0 in. Below Design Excavation Limits
- Step 6—Final Field Verification Sampling of Excavation
- Step 7—Placement of Excavation into Stable Condition Waiting for Sampling Laboratory Analysis
- Step 8—Mass Backfill Operations
- Step 9—Installation of Final Permanent Utilities/Structures
- Step 10—Final Grading and Contouring/Placement of Finish Grade Gravel or Placement of Topsoil and Revegetation
- Step 11—Removal of Decontamination Areas/Fencing/and other Temporary Construction
- Step 12—Demobilization from Site.

The sites that will undergo mass excavation operations are CPP-97, -34A, -34B, -03, and -67 (Evaporation Ponds 1 and 2).

Requirements for vendor data submittals, training, and medical information specified by the construction specifications and INEEL-specific requirements will be provided in the Request for Proposal (RFP). The subcontractor will provide required documentation, bonds, insurance, and proof that all required training and medical examinations are complete as per the HASP (Attachment 4 of the Group 3 RD/RA Work Plan submittal [DOE-ID 2004a]) before the subcontractor will be allowed to mobilize. These submittals will certify that the subcontractor can meet and satisfy the requirements of the RFP and the project.

1.4.2.1 Site Mobilization (Step 1). Mobilization is the work performed in preparation for construction activities. This work generally implements the project and site-required administrative, engineering, and health and safety controls. Mobilization will include such activities as setup of site offices; demarcation of parking areas, equipment and material lay down areas, and work zones; and installation of signs, postings, and fences. Required lay down areas, work zones, and postings will be set up and maintained for each phase of the remediation. Coordination of the remediation activities will be required between contractor, subcontractor, and facility personnel to ensure that these activities have minimal impact on facility operations and maintenance.

Site preparation includes utility identification and isolation, security fencing/barrier installation (if necessary), site layout and surveying, establishment of storm water runoff barriers and collection points, set up of a temporary decontamination station, set up of dust control operations, and any required air monitoring. These activities are briefly discussed in the following sections.

1.4.2.2 Establishment of Perimeter Fencing and Site Boundary (Step 2). Temporary security barriers and/or fencing and access-control fencing will be installed to restrict access by wildlife or unauthorized personnel into the work area and to prevent drilling and heavy equipment from driving over subsurface structures. Existing barriers and/or fencing that will be impacted by remediation activities will be removed and/or relocated where necessary. Existing fencing around portions of the site may be used to establish the access control boundary. Ingress and egress control of contaminated areas will be defined in the HASP (Attachment 4) under security fencing.

1.4.2.3 Establishment of Decontamination Areas and Systems (Step 3). The remediation operations will establish appropriate equipment and transport vehicle decontamination areas and/or systems as necessary to assure the containment of contamination within the specific site boundary. This delineation is necessary to assure that contamination is not spread from the specific site boundary to the surrounding areas at INTEC and transportation roadways to the ICDF for waste disposal.

These decontamination areas and systems will be delineated after the award of the remediation subcontract and will use the best available technology to provide adequate decontamination of equipment and transport vehicles while minimizing the generation of secondary waste streams.

1.4.2.4 Location and Isolation of Utilities (Step 4). The specific site utilities will be located in the field using the existing as-built engineering drawings and physical surveys of field conditions. These utilities will be isolated and demolished as shown on design drawings to allow the excavation to be completed to the required depth to meet the RGs. Once the remediation has been accomplished, these utilities will be re-installed as shown on the design drawings prior to and/or in conjunction with backfill operations.

1.4.2.5 Mass Excavation (Step 5). Field screening using a gamma spectrometer will be performed during the excavation. The flow chart presented in Section 5 of this Work Plan (DOE-ID 2004a) will be followed to determine when the excavation is complete. Note that there will be no excavation into basalt.

The general sequencing of mass excavation activities is as follows:

- Excavation will typically proceed in 1-foot lifts (to minimize the excavation quantities while removing contamination greater than the RGs and to minimize placement of noncontaminated materials that could be used for backfill materials into the ICDF landfill) (Step 5a).

- A water truck or other forms of water distribution equipment will be used for dust control (additional water spray systems may be required at the dig face during excavation operations).

- Material will be excavated and moved to the edge of the excavation for loading into selected transportation equipment.

- Roll-offs with plastic liners or dump trucks with solid formed dump beds (designed to avoid leakage of materials) will be loaded by the tracked excavator or loader and moved to the decontamination station without entering the zone of contamination.

- Loaded roll-offs or dump trucks will be surveyed for radiological contamination and be dry decontaminated, if necessary. Any dirt or mud on the truck chassis will be removed by the laborers working at the decontamination station.

- An option for dump trucks not using a foldable plastic cover is to spray a water-soluble fixatant on truck loads to maintain surface integrity and provide dust control. Spray fixatant will require an exception from ICDF Operations since this system is not currently specified in the ICDF landfill Waste Acceptance Criteria (WAC). Only tarp-covered loads (a more time-consuming option than the spray fixatant) are currently specified for trucks hauling bulk waste materials to ICDF.

- The roll-offs or transport trucks will transfer the waste soil and debris to the ICDF, where ICDF Operations will review the waste manifests, accept the truck, and dispose of the waste.

- Field screening and contamination removal accomplished by additional excavation of hot spots to the preestablished 10 ft 0 in. bgs or design depth are iterative processes that must be worked dependent upon field conditions (Step 5b).

1.4.2.6 Final Field Verification Sampling and Geophysical Survey of Excavation (Step 6). The final field verification sampling will be performed to verify that RGs have been met as described in the Field Sampling Plan (FSP) (DOE-ID 2004b) (Attachment 1 of the Group 3 RD/RA Work Plan submittal [DOE-ID 2004a]). The excavation will be surveyed to establish backfill material needs.

1.4.2.7 Placement of Excavation into Stable Condition waiting for Sampling Laboratory Analysis (Step 7). The excavation will be placed into a safe and stable configuration to allow the excavation to remain open until the final field compliance sample results are verified and validated (a period of 30 to 90 days depending upon certified laboratory backlog and schedule).

1.4.2.8 Mass Backfill Operations (Step 8). Following verification that the RGs have been met, the excavation may be backfilled, as described in design earthwork specifications. Backfill will be placed and compacted to meet the requirements of the earthwork specification for future use of the site.

1.4.2.9 Installation of Final Permanent Utilities (Step 9). Utilities will be re-installed and tested as required. Security barriers/fencing and animal control fencing will be reinstalled as required. Utility re-installation will be performed in conjunction with backfill operations.

1.4.2.10 Final Grading and Contouring/Placement of Finish Grade Gravel or Placement of Topsoil and Revegetation (Step 10). Final grading and contouring of the site topography as required by the design drawings and placement of topsoil and revegetation of those sites requiring such (Site CPP-67) will be performed.

1.4.2.11 Removal of Decontamination Areas/Fencing/and other Temporary Construction (Step 11). Removal of the temporary decontamination station will include final sampling and transfer of wash water to the ICDF evaporation pond for disposal per the project Waste Management Plan (WMP) (DOE-ID 2004c) (Attachment 6 of the Group 3 RD/RA Work Plan submittal [DOE-ID 2004a]).

1.4.2.12 Demobilization from Site (Step 12). Site cleanup and demobilization will include completion of the final site punch-list, removal of equipment, and re-posting of the site boundary.

1.4.3 Remediation—Boxed Waste Transfer Operations

The sites that will undergo boxed waste transfer operations are CPP-92, -98, and -99. These waste boxes are currently located in the Staging and Storage Annex (SSA) CPP-1789. These boxes are in good physical condition and are currently inspected weekly under the Agency-approved WMP for the SSA (DOE-ID 2003). This remedial operation will be fairly simple and straightforward, consisting of transporting boxed waste from SSA CPP-1789 to the ICDF. This is a routine waste handling operation and existing procedures are in place to cover such work.

The general sequencing of operations for this remedial action is outlined below:

- Boxes will be presorted prior to collecting additional characterization samples
- Additional characterization samples will be collected and analyzed per the Characterization Plan (DOE-ID 2004d) (Attachment 3 of the Group 3 RD/RA Work Plan submittal [DOE-ID 2004a])
- Waste profiles will be developed and a determination made regarding ICDF WAC acceptability and/or applicability for stabilization to meet LDRs
- Soil and debris waste boxes will be transferred to ICDF for direct disposal and/or to the Staging, Storage, Sizing, and Treatment Facility within the ICDF Complex for treatment, as necessary.

1.4.3.1 Transfer of Soil and Debris Waste Boxes to ICDF. The specific sequencing of operations associated with the transfer of the soil and debris waste boxes to the ICDF from CPP-1789 is outlined below. Soil and debris box sequences are presented separately.

- Waste Soil Boxes
  - A site boundary of sufficient size will be established to allow staging of a transport trailer and tractor unit outside of CPP-1789.

- A forklift with sufficient capacity will be used to move boxes from CPP-1789 and load them onto the tractor-trailer unit. Loading will be limited by weight loading restriction on tractor-trailer unit.

- The load will be tied down and secured to the trailer unit and a final radiological survey performed for release.

- The tractor-trailer unit will be driven from the CPP-1789 site boundary to ICDF.

- The tractor-trailer unit will enter ICDF and proceed to the truck scale for weighing.

- The tractor-trailer unit will proceed as directed to the staging area to drop off the trailer. ICDF operations personnel will unload the trailer at a later time or as directed to the ICDF active cell for direct unloading.

- If directed to the ICDF active cell for direct unloading, the tractor-trailer will go to the decontamination facility for decontamination prior to final weighing.

- The tractor-trailer will proceed from ICDF to the CPP-1789 site boundary for waste box loading operations.

• Waste Debris Boxes

- A site boundary of sufficient size will be established to allow staging of a transport trailer and tractor unit outside of CPP-1789.

- A forklift with sufficient capacity will be used to move boxes from CPP-1789 and load them onto the tractor-trailer unit. Loading will be limited by weight loading restrictions on the tractor-trailer unit.

- The load will be tied down and secured to the trailer unit and a final radiological survey performed for release.

- The tractor-trailer unit will be driven from the CPP-1789 site boundary to ICDF.

- The tractor-trailer unit will enter ICDF and proceed to the truck scale for weighing.

- The tractor-trailer unit will proceed as directed to the staging area to drop off the trailer. ICDF operations personnel will unload the trailer at a later time or unload the boxes and place them directly in the staging area.

- The tractor-trailer unit will go to the decontamination facility for decontamination prior to final weighing.

- The tractor-trailer unit will proceed from ICDF to the CPP-1789 site boundary for waste box loading operations.

2. HAZARD IDENTIFICATION AND MITIGATION

This section identifies existing and anticipated chemical, radiological, safety, and environmental hazards based on the Operable Unit 3-13, Group 3, Other Surface Soils, Remediation Phase I scope of work and provides controls to eliminate or mitigate these hazards. This will enable project management and safety and health professionals to make effective and efficient decisions regarding the equipment, processes, procedures, and allocation of resources to protect the safety and health of project personnel.

The following method was used to identify the hazards and the most effective way to mitigate them:

- Evaluate each project task to determine the safety hazards and radiological, chemical, and biological exposure potential to project personnel by all routes of entry
- Establish the necessary monitoring and sampling required to evaluate exposure and contamination levels, determine action levels to prevent exposures, and provide specific actions to be following if action levels are reached
- Determine the necessary engineering controls, isolation methods, administrative controls, work practices, and personal protective equipment (PPE) to further protect project personnel from hazards.

The magnitude of or danger presented by hazards to personnel entering work zones is dependent on both the nature of tasks being performed and the proximity of personnel to the hazards. Engineering controls will be implemented (whenever possible) along with administrative controls, work practices, and PPE to mitigate potential exposures and hazards. Hazard mitigation provided in this section in combination with other work controls (e.g., technical procedures [TPRs], work orders, job safety analysis, and GDE–6212, "Hazard Mitigation Guide for Integrated Work Control Processes") will be used, where applicable, to eliminate or mitigate project hazards.

2.1 Chemical and Radiological Hazards and Mitigation

Personnel may be exposed to chemical and radiological hazards while working at the OU 3-13, Group 3, Other Surface Soils Remediation Phase I sites. Table 2-1 lists the worker health-based chemical contaminants of concern (COCs) that may be encountered while conducting project tasks. Table 2-2 lists the worker health-based radiological COCs that may be encountered during project tasks. Table 2-3 lists the exposure limits, routes of entry, target organs, level of carcinogen exposure, and matrix or source of contaminant for the dominant radioisotopes. Table 2-4 outlines the activities, associated hazards, and hazard mitigation elements.

Table 2-1. Worker health-based chemical contaminants of concern.

Chemical or Compound	Matrix or Source	Average Level Detected (mg/kg)[a]	Maximum Level Detected (mg/kg)	On-Site Background (mg/kg)[b]
Ag	CPP-03	NA[c]	NA	NA
	CPP-34	2.2	2.5	0
	CPP-37B	4.19	8.5	NA
	CPP-67	2.91	18	NA
Pb	CPP-03	NA	NA	NA
	CPP-34	14.1	132	17
	CPP-37A	11	17.7	NA
	CPP-37B	9.6	22.6[d]	NA
	CPP-67	8.49	19.5[d]	NA
Hg	CPP-03	NA	NA	NA
	CPP-34	0.35	0.6	0.05
	CPP-37A	0.57	0.96	NA
	CPP-37B	0.12	0.12[d]	NA
	CPP-67	12.6	126[d]	NA
Bis (2-ethylhexyl) phthalate	CPP-03	NA	NA	NA
	CPP-34	0.54	0.62	NA
	CPP-37B	0.24	0.24[d]	NA
	CPP-67	1.31	3.7	NA
Se	CPP-34	0.7	0.7	0.22
	CPP-37A	0.234	0.41	NA
	CPP-37B	0.281	0.65	NA
	CPP-67	0.388	0.8[d]	NA
As	CPP-34	NA	7.1	5.8
	CPP-37A	5.83	8.7	NA
	CPP-37B	4.42	11.4[d]	NA
	CPP-67	4.52	13.8	NA
Methylene chloride	CPP-37A	0.0893	0.14	NA
	CPP-37B	0.12	0.29	NA
	CPP-67	0.00963	0.024[d]	NA
Toluene	CPP-37A	0.001	0.001[d]	NA
	CPP-67	0.001	0.001[d]	NA
1,1,1-Trichloroethane	CPP-37A	0.005	0.005[d]	NA
	CPP-67	0.001	0.001[d]	NA
Ba	CPP-37B	126	468	300
	CPP-67	144	400	NA
Cd	CPP-37B	1.22	3.2	2.2
	CPP-67	1.82	11.2	NA
Cr	CPP-37B	18.5	42.6	33.0
Kepone	CPP-37B	0.07	0.07[d]	NA
Acenaphthene	CPP-37B	0.037	0.037[d]	NA

Table 2-1. (continued).

Chemical or Compound	Matrix or Source	Average Level Detected (mg/kg)[a]	Maximum Level Detected (mg/kg)	On-Site Background (mg/kg)[b]
Fluorene	CPP-37B	0.061	0.061[d]	NA
Pyrene	CPP-37B	0.21	0.21[d]	NA
Benzo (a) Anthracene	CPP-37B	0.072	0.072[d]	NA
Phenanthrene	CPP-37B	0.4	0.4	NA
Anthracene	CPP-37B	0.35	0.35	NA
Fluoranthene	CPP-37B	0.22	0.22[d]	NA
Chrysene	CPP-37B	0.11	0.11[d]	NA
Aroclor 1254	CPP-37B	0.23	0.23	NA
Aroclor 1260	CPP-37B	0.42	0.42	NA
Cu	CPP-67	24.3	149[d]	22
Sb	CPP-67	1.42	6.9	4.8
Cyanide	CPP-67	0.29	0.52	NA
Sulfide	CPP-67	8.1	15.7	NA
2-Butanone	CPP-67	0.008	0.009[d]	NA
Acetone	CPP-67	0.0239	0.091	NA
Benzene	CPP-67	0.001	0.001[d]	NA
Butylbenzyl-phthalate	CPP-67	0.612	1.4	NA
Carbon disulfide	CPP-67	0.014	0.014	NA
Chlorobenzene	CPP-67	0.001	0.001[d]	NA
Di-n-butylphthalate	CPP-67	0.0892	0.13[d]	NA
Diethyl-phthalate	CPP-67	0.041	0.041	NA
Pentachloro-phenol	CPP-67	0.37	0.37[d]	NA

a. Taken from the Final Record of Decision, Idaho Nuclear Technology and Engineering Center (DOE-ID 1999).

b. The INEEL background concentrations represent the 95% upper confidence limit (Rood et al. 1996).

c. NA = Not available.

d. The analyte was identified in the sample but the numerical result may not be accurate.

Table 2-2. Worker health-based radiological contaminants of concern.

Radionuclide	Matrix or Source	Average Activity Detected (pCi/g)[a]	Maximum Level Detected (pCi/g)	On-Site Background (pCi/g)[b]
Sr-90	CPP-03	30.0	43.9	0.49
	CPP-34	813	6000	NA[c]
	CPP-37A	0.37	0.69	NA
	CPP-37B	0.93	4.31	NA
Am-241	CPP-67	NA	NA	NA
	CPP-37A	0.476	0.99	0.01
	CPP-37B	1.18	3.89	NA
	CPP-67	0.631	7.8	NA
Np-237	CPP-67	NA	NA	NA
	CPP-03	NA	NA	NA
	CPP-34	0.7	0.7	NA
	CPP-37A	0.662	1.07	NA
	CPP-37B	0.513	0.86	NA
	CPP-67	1.12	1.63	NA
Pu-238	CPP-67	NA	NA	NA
	CPP-03	NA	NA	NA
	CPP-34	5.1	5.1	0.0049
	CPP-37A	0.11	0.12	NA
	CPP-37B	0.199	0.5	NA
	CPP-67	6.1	30.4	NA
Pu-239	CPP-67	0.549	2.07	0.1
U-234	CPP-67	NA	NA	NA
	CPP-03	NA	NA	NA
	CPP-34	1.47	2.5	1.44
U-238	CPP-67	NA	NA	NA
	CPP-03	NA	NA	NA
	CPP-34	1.71	2.8	1.4
	CPP-37A	0.727	3.99	NA
	CPP-37B	0.787	7.44	NA

Table 2-2. (continued).

Radionuclide	Matrix or Source	Average Activity Detected (pCi/g)[a]	Maximum Level Detected (pCi/g)	On-Site Background (pCi/g)[b]
Cs-137	CPP-03	18.9	65.1	0.82
	CPP-34	396	2000	NA
	CPP-37A	1.13	3.82	NA
	CPP-37B	2.04	6.31	NA
	CPP-67	40.6	180	NA
Eu-152	CPP-03	NA	NA	NA
Co-60	CPP-37A	0.5	0.5	NA
	CPP-67	0.599	2.35	NA
U-235	CPP-37A	0.05	0.05	NA
	CPP-37B	0.0575	0.07	NA
I-129	CPP-37B	1.57	1.57	NA
	CPP-67	2.5	3.7	NA
Ce-144	CPP-67	0.923	1.5	NA
Cs-134	CPP-67	1.5	3.5	NA
Eu-154	CPP-67	1.63	4	NA
H-3	CPP-67	0.61	0.61[d]	NA
Ru-106	CPP-67	3.45	5.97	NA

a. Taken from the Final Record of Decision, Idaho Nuclear Technology and Engineering Center (DOE-ID 1999).

b. The INEEL background concentrations represent the 95% upper confidence limit (Rood et al. 1996).

c. NA = Not available.

d. The analyte was identified in the sample but the numerical result may not be accurate.

Table 2-3. Exposure evaluation of dominant radioisotopes at the OU 3-13, Group 3, sites.

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Silver CAS: 7440-22-4	OSHA PEL 0.01mg/m^3 ACGIH TLV 0.1 mg/m^3	Inhalation, ingestion, skin contact	Acute: Eye and skin irritation, possible contact dermatitis. Irritating to mucous membranes and upper respiratory tract. Extremely high exposures cause lung damage with pulmonary edema. Chronic: Argyria is a condition arising from the accumulation of silver in the body and is characterized by an unsightly, widespread blue-grey discoloration of the skin that can persist for long periods of time. The skin of exposed workers may also become black and have a metallic luster. Argyria may manifest in the conjunctiva of the eye, which may be affected sufficiently to cause lens and visual disturbances.	Skin, eyes, respiratory tract	No	Source in waste and in surface soils
Methylene Chloride CAS: 75-09-2 Vapor Density 2.9	OSHA PEL 25 ppm STEL 125 ppm ACGIH TLV 50 ppm	Inhalation, ingestion, skin contact	Acute: Mental confusion, light-headedness, fatigue, nausea, vomiting Chronic: Headache, depression, liver effects, kidney effects, bronchitis, loss of appetite, nausea, visual disturbances.	Kidneys, liver respiratory/ cardiovascular systems	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Lead CAS: 7439-92-1	OSHA PEL 0.05 mg/m^3 ACGIH TLV 0.05 mg/m^3	Inhalation, ingestion, skin contact	Acute: Irritating to eyes, skin, respiratory system; muscle weakness. Repeated or prolonged skin contact may result in sensitization (dermatitis). Chronic: Brain and kidney damage, impaired hearing, vomiting, appetite loss, behavioral problems, increased blood pressure, digestive problems, nerve disorders, reproductive effects.	Eyes, skin, respiratory system, CNS, gastrointestinal, kidneys, blood, neurological, reproductive system	Yes IARC	Source in waste and in surface soils
Mercury CAS: 7439-97-6 Vapor Density 7.0	OSHA PEL 0.1 mg/m^3 ACGIH TLV 0.025 mg/m^3	Inhalation, ingestion, skin contact	Acute: Burns to eyes, skin, and respiratory tract. Sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis, CNS disturbances, gingivitis, memory loss, diarrhea, nephritis, anxiety, headache, weight loss, insomnia.	Eyes, skin, CNS, respiratory system, gastrointestinal system, gums, neurological, kidneys	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			Chronic: Gum/Mouth inflammation, CNS damage, muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Can cause skin allergies and accumulate in the body. A suspected reproductive hazard, may damage the developing fetus and decrease fertility in males and females.			
Bis (2-ethylhexyl) phthalate CAS: 117-81-7 Vapor Density 13.5	OSHA PEL 5 mg/m^3 STEL 10 mg/m^3 ACGIH TLV 5 mg/m^3 STEL 10 mg/m^3	Inhalation, skin contact	Acute: Mild eye and skin irritation, including stinging, tearing and redness of eyes, and redness and burning of skin. Cough. Sore throat, abdominal cramps, diarrhea, nausea. Chronic: Effects include a slow-down in muscle coordination, mood swings, erratic behavior, loss of memory, loss of sensation/feeling, and nerve conductive loss.	Eyes, skin, respiratory system, gastrointestinal	Yes IARC, NTP	Source in waste and in surface soils
Selenium CAS: 7782-49-2	OSHA PEL 0.2 mg/m^3 ACGIH TLV 0.2 mg/m^3	Inhalation, ingestion, skin contact	Acute: Irritated upper respiratory tract, shortness of breath, bronchi spasms, pulmonary edema, headache, fever, chills, stomach problems, skin burns/rash, eye irritation.	Skin, eyes, kidney, liver, lungs, gastrointestinal tract	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			Chronic: Respiratory tract and gastrointestinal tract effects. Dermatitis, nausea, vomiting, cough, yellowish skin discoloration, loss of nails, garlic breath, and bad teeth.			
Arsenic CAS: 7440-38-2	OSHA PEL mg/m^3 ACGIH TLV 1.0 mg/m^3	Inhalation, ingestion, skin contact	Acute: Inflammation of mucous membranes, cough, foamy sputum, dyspnea, cyanosis, vomiting, bloody diarrhea, low blood pressure, cramps, convulsions, coma, skin irritation, redness, itching, or pain. Itching, burning, watering eyes Chronic: Bronzing of the skin, edema, dermatitis, and lesions. Hair/weight loss, garlic odor to breath/perspiration, excessive salivation and perspiration, hepatitis, gastrointestinal disturbances.	Cardiovascular system, CNS, skin	No	Source in waste and in surface soils
Toluene CAS: 108-88-3 Vapor Density 3.20	OSHA PEL 200 ppm ACGIH TLV 50 ppm	Inhalation, ingestion, skin contact	Acute: Headache, dizziness, anesthesia, drowsiness, unconsciousness, brain damage, eye and respiratory tract irritation. Chronic: Prolonged/repeated skin contact may result in dermatitis. May also cause liver, kidney, and brain damage.	Eyes, skin, respiratory tract, CNS, liver, kidney	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Trichloroethane CAS: 71-55-6 Vapor Density 4.54	OSHA PEL 350 ppm ACGIH TLV 350 ppm	Inhalation, ingestion, skin contact	Acute: Mild hepatic effects, and CNS depression. Cardiac arrhythmia and respiratory arrest may result from the depression of the CNS. Other symptoms include dizziness, nausea, vomiting, diarrhea, unconsciousness, decreased blood pressure, irritation of the gastrointestinal tract, reddened, rough, and dry skin, cough, loss of sense and balance, visual disturbances, loss of appetite Chronic: May damage liver and cardiovascular system.	CNS, eyes, skin, liver, gastrointestinal tract, cardiovascular system	No	Source in waste and in surface soils
Barium CAS: 7440-39-3	OSHA PEL 10 mg/m^3 ACGIH TLV 0.5 mg/m^3	Inhalation, ingestion, skin contact	Acute: Eye, skin, nose, mouth, throat, and upper respiratory tract irritation. May cause severe gastroenteritis, including abdominal pain, vomiting and diarrhea, tremors, faintness, paralysis of the arms and legs, and slow or irregular heartbeat. Severe cases may produce collapse and death due to respiratory failure. Soluble barium compounds are more likely to cause these effects than insoluble compounds. Inhalation of fumes may cause sore throat, coughing, labored breathing, and irritation of the respiratory tract as well as the above symptoms.	Respiratory system, eye, skin, immune system (allergic reactions), central nervous system, and heart	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			Chronic: Prolonged contact with eyes and skin may result in severe irritation or burns.			
Cadmium CAS: 7440-43-9 Vapor Density 3.9	OSHA PEL 0.2 mg/m3 (dust) ACGIH TLV 0.01 mg/m3 (dust)	Inhalation, ingestion	Acute: Mucous membrane irritation, dry mouth/throat, headache, nausea, dizziness. High inhalation exposure to oxide fume can cause respiratory irritation, pneumonitis and metal fume fever. Such exposure may be fatal. High ingestion exposure of soluble cadmium salts causes acute gastroenteritis. Chronic: Lung injury, kidney disease. Further effects include obstructive lung disease (probably lung cancer), kidney dysfunction or incipient kidney failure, kidney stones, skeletal collapse due to interference with the metabolism of calcium. Other effects reported are hypertension, reduced life span, prostate cancer, suppression of testicular function, and disruption of a number of enzyme systems.	Respiratory system, kidneys, blood, prostate	Yes IARC	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Chromium CAS: 7440-47-3	OSHA PEL 0.5 mg/m^3 ACGIH TLV 0.05 mg/m^3	Inhalation, ingestion	Acute: Red, dry throat, gastrointestinal disorders, irritation of eyes and skin. Chronic: Repeated or prolonged contact may cause skin sensitization. Histologic fibrosis of lungs, nasal and/or lung cancer.	Respiratory system	Yes IARC	Source in waste and in surface soils
Kepone CAS: 143-50-0	Not established	Inhalation, ingestion, skin contact	Acute: Headache, anxiety, tremor, liver damage, kidney damage, visual disturbance, ataxia, chest pain, skin erythema (skin redness). Chronic: Testicular atrophy, low sperm count, cancer.	Eyes, skin, respiratory system, CNS, liver, kidneys, reproductive system	Yes IARC NTP	Source in waste and in surface soils
Acenaphthene CAS: 83-32-9	Not established, however, OSHA and ACGIH recommended PEL/TLV 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction)	Inhalation, ingestion, skin contact	Acute: Eyes, skin, digestive and respiratory tract irritation. Chronic: May cause lung irritation, bronchitis with cough and phlegm, and shortness of breath. May affect the liver and kidneys.	Eyes, skin, liver, kidneys	No	Source in waste and in surface soils
Fluorene CAS: 86-73-7	Not established	Inhalation, ingestion	Acute: Skin, eye, and respiratory irritant. Chronic: None known	Eyes, skin, respiratory tract	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Pyrene CAS: 50-32-8 Vapor Density 8.7	OSHA PEL 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction) ACGIH TLV 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction)	Inhalation, ingestion, skin contact	Acute: Eye, skin, upper respiratory tract irritation. Chronic: May cause bladder, skin and lung cancer. May damage the developing fetus. May cause reproductive damage. May cause changes to the color and properties of skin. Exposure to sunlight can increase the skin damage caused by this chemical.	Liver, kidneys blood, skin	Yes IARC	Source in waste and in surface soils
Benzo (a) Anthracene CAS: 56-55-3	Not established	Inhalation, ingestion, skin contact	Acute: No human exposure information available. Chronic: No human exposure information available.	No human exposure information available	Yes IARC	Source in waste and in surface soils
Phenanthrene CAS: 85-01-8	OSHA PEL 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction) ACGIH TLV 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction)	Inhalation, ingestion, skin contact	Acute: Rash or burn with blisters on skin, nose and throat irritation, photosensitivity Chronic: Skin allergy with itching and rashes.	Eyes, skin	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Anthracene CAS: 120-12-7	OSHA PEL 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction) ACGIH TLV 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction)	Inhalation, skin contact	Acute: Itching/burning skin; irritated nose, throat, and lungs; burns and irritates eyes, Chronic: Skin allergy. Repeated contact may cause thickening of skin, yellow-brown patchy areas, loss of skin pigment.	Skin	No	Source in waste and in surface soils
Fluoranthene CAS: 206-44-0	Not established	Inhalation, ingestion, skin contact	Acute: Eye irritation Chronic: No human exposure information available.	Eyes	No	Source in waste and in surface soils
Chrysene CAS: 218-01-9	OSHA PEL 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction) ACGIH TLV 0.2 mg/m^3 as coal tar pitch volatile (benzene soluble fraction)	Inhalation, ingestion, skin contact	Acute: Skin irritation. Chronic: No human exposure information available.	Skin	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Aroclor 1254 PCB CAS: 11097-69-1	OSHA PEL 0.5 mg/m^3 ACGIH TLV 0.5 mg/m^3	Inhalation, ingestion, skin contact	Acute: Dry red skin, red painful eyes, headache, numbness, fever. Chronic: Respiratory tract symptoms, such as cough and tightness of the chest. Gastrointestinal effects including anorexia, weight loss, nausea, vomiting, and abdominal pain. Mild liver effects and effects on the skin and eyes, such as chloracne, skin rashes, and eye irritation. PCB ingestion associated with cardiovascular effects, including hypertension, mild liver effects, and effects on the skin such as pigmentation and acne. Cancer.	Eyes, skin, CNS, liver	Yes IARC	Source in waste and in surface soils
Aroclor 1260 PCB CAS: 11096-82-5	OSHA PEL 0.5 mg/m^3 ACGIH TLV 0.5 mg/m^3	Inhalation, ingestion, skin contact	Acute: Dry, red skin, red painful eyes, headache, numbness, fever Chronic: Respiratory tract symptoms, such as cough and tightness of the chest. Gastrointestinal effects including anorexia, weight loss, nausea, vomiting, and abdominal pain. Mild liver effects and effects on the skin and eyes, such as chloracne, skin rashes, and eye irritation.	Eyes, skin, CNS, liver	Yes IARC	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			PCB ingestion associated with cardiovascular effects, including hypertension, mild liver effects, and effects on the skin such as pigmentation and acne. Cancer.			
Copper CAS: 7440-50-8	OSHA PEL 1 mg/m^3 (dust) ACGIH TLV	Inhalation, ingestion	Acute: Sneezing, coughing, nausea, vomiting, dizziness, gastrointestinal disturbances, skin and eye irritation, headaches. Chronic: Dermatitis.	Eyes, skin, gastrointestinal	No	Source in waste and in surface soils
Tin CAS: 7440-31-5	OSHA PEL 2 mg/m^3 (inorganic) ACGIH TLV 2 mg/m^3	Inhalation, ingestion	Acute: Metallic taste, respiratory tract, nose/throat irritation, coughing. Headache, dizziness, difficulty breathing. Nausea, vomiting, cramps, diarrhea. Skin-redness, burning, rash, dryness. Eye-redness, burning, tearing, blurred vision. Chronic: No human exposure information available.	Skin	No	Source in waste and in surface soils
Cyanide CAS: 74-90-8 Vapor Density 0.94	OSHA PEL 5 mg/m^3 ACGIH TLV 5 mg/m^3	Inhalation, ingestion, skin contact	Acute: Bleeding, weakness, headache, confusion, vertigo, fatigue, anxiety, dyspnea, and, occasionally, nausea and vomiting. Respiratory distress, coma and convulsions may occur.	Eyes, upper respiratory tract, gastrointestinal, thyroid	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			If large amounts are absorbed, collapse is usually instantaneous; unconsciousness, often with convulsions, is followed soon by death. Chronic: Exposure at concentrations from 4 to 12 ppm for 7 years showed an increase in headaches, vertigo, weakness, changes in taste and smell, irritation of the throat, vomiting, effort dyspnea, lacrimation, abdominal colic, precordial pain, and nervous instability. Dermatitis, itching, scarlet rash, papules, and severe nose irritation. Thyroid changes, including frank goiter. Only occasionally has reference been made to eye irritation, conjunctivitis, or superficial keratitis developing.			
Sulfide CAS: 7783-06-4 Vapor Density 1.21	OSHA PEL 20 ppm ceiling ACGIH TLV 10 ppm STEL 15 ppm	Inhalation, ingestion, skin contact	Acute: Eye, mucous membrane, and skin irritation. Headache, nausea dizziness, coma, unconsciousness, pulmonary paralysis, sudden collapse, death.	Eyes, respiratory system	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			Chronic: Repeated exposure at low concentrations may cause conjunctivitis, photo phobia, corneal bullea, tearing, pain, blurred vision.			
2-Butanone (MEK) CAS: 78-93-3 Vapor Density 2.5	OSHA PEL 200 ppm ACGIH TLV 200 ppm STEL 300 ppm	Inhalation, ingestion, skin contact	Acute: Headaches, vomiting, nausea, weakness, dizziness. Eye, nose, throat irritation. Difficult breathing, CNS depression, respiratory failure. Chronic: Corneal injury, dermatitis, chemical pneumonitis and pulmonary edema	CNS, respiratory system	No	Source in waste and in surface soils
Acetone CAS: 67-64-1 Vapor Density 2.0	OSHA PEL 750 ppm STEL 1000 ppm ACGIH TLV 500 ppm STEL 750 ppm	Inhalation, ingestion, skin contact	Acute: Restlessness, slow reaction time, slurred speech, nausea, vomiting, dizziness, ataxia, intoxication, sensory disturbances, rapid pulse, sweating, drowsiness, stupor, coma. Chronic: Severe irritation or dermatitis. Prolonged exposure to the vapor irritates the skin. Repeated and prolonged contact of the liquid with skin can cause dryness and erythema (inflammation). Corneal injury may occur.	CNS, liver, kidneys	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Benzene CAS: 71-43-2 Vapor Density 2.7	OSHA PEL 1 ppm 5 ppm ceiling ACGIH TLV 0.5 ppm STEL 2.5 ppm	Inhalation, ingestion	Acute: Drowsiness, dizziness, headache, nausea, loss of coordination, confusion and unconsciousness. Vomiting, delirium, convulsions, respiratory paralysis, death. Skin, eye, upper respiratory tract irritation. Chronic: Redness, dryness, cracking (dermatitis) due to the defatting action; pancytopenia may be followed by aplastic anemia or leukemia. Additional symptoms included an increased incidence of headaches, fatigue, difficulty sleeping and memory loss among workers with significant exposures.	Blood and blood-forming organs, immune system, CNS, respiratory system	Yes IARC NTP ACGIH-A1	Source in waste and in surface soils
Butyl benzyl-phthalate CAS: 85-68-7	Not established	Inhalation	Acute: Irritates the eyes, the skin, and the respiratory tract. Chronic: May have effects on the liver and kidneys resulting in impaired functions.	Liver, kidneys	No	Source in waste and in surface soils
Carbon Disulfide CAS: 75-15-0 Vapor Density 2.67	OSHA PEL 20 ppm 30 ppm ceiling ACGIH TLV 4 ppm STEL 12 ppm	Inhalation, ingestion, skin contact	Acute: Severe skin, eye, and respiratory irritant. May cause headache, dizziness, fatigue, muscle weakness, numbness, nervousness, or psychological disturbances.	Liver, kidney, CNS, eyes	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
	Ceiling 30 ppm		Chronic: Liver, kidney, CNS damage, and impaired vision. Can cause increased atherosclerosis, leading to risk of cardiovascular disease. Prolonged exposure of female workers to low concentrations of carbon disulfide has been associated with birth defects in offspring.			
Chlorobenzene CAS: 108-90-7 Vapor Density 3.88	OSHA PEL 75 ppm ACGIH TLV 10 ppm	Inhalation, ingestion	Acute: Severe skin, eye, and respiratory irritation, headaches, CNS damage, corneal damage, vomiting. Chronic: Dermatitis, skin burns, kidney, lung and liver damage. CNS effects include numbness, cyanosis, hyperesthesia (increased sensation), and muscle spasms. Headaches and irritation of the mucosa of the upper respiratory tract and eyes.	Liver, kidneys, CNS, lungs	No	Source in waste and in surface soils
Di-n-butylphthalate CAS: 84-74-2 Vapor Density 9.6	OSHA PEL 5 mg/m^3 ACGIH TLV 5 mg/m^3	Inhalation, ingestion, skin contact	Acute: Irritates eyes, skin, respiratory tract. Symptoms may include nausea, vomiting, and diarrhea. Chronic: CNS effects include pain, numbness, weakness and spasms in the extremities.	Eyes, skin, respiratory tract, CNS	No	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Diethyl-phthalate CAS: 84-66-2 Vapor Density 7.66	OSHA PEL Not established ACGIH TLV 5 mg/m^3	Inhalation, ingestion	Acute: Coughing, chest pain, and shortness of breath. Higher exposures may cause central nervous system effects. Gastrointestinal tract irritation. Eye irritation, with redness and pain. Chronic: No information found.	Eyes, respiratory system, gastrointestinal, CNS	No	Source in waste and in surface soils
Pentachloro-phenol CAS: 87-86-5 Vapor Density 9.2	OSHA PEL 0.5mg/m^3 ACGIH TLV 0.5mg/m^3	Inhalation, ingestion, skin contact	Acute: Cough. dizziness, drowsiness, headache. Fever or elevated body temperature. Labored breathing, sore throat. Irritates skin (redness and/or blisters). Irritates eyes (redness and pain). Abdominal cramps, diarrhea. nausea, unconsciousness, vomiting, weakness. Damage to liver and kidneys. Chronic: mutates living cells, may damage a developing fetus. Repeated exposures may damage liver, kidneys, blood, and nervous system. Bronchitis, skin rash, weight loss, weakness, excessive sweating. Possible cancer.	Eyes, skin, respiratory tract, cardiovascular, gastrointestinal, liver, kidney, CNS	Yes IARC	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Radionuclides—Cs-137, Sr-90, and Pu-238 (dominant radioisotopes, OU 3-13, Group 3, Other Surface Soils, remediation project)						
Radionuclides (whole-body exposure)	As stated in limiting condition section of radiological work permit.	Inhalation, ingestion, and injection. Note α and β particles pose a skin contact hazard.	Acute: Bone Marrow Syndrome (dose, 0.7 – 10 Gy): anorexia, nausea, vomiting followed by bone marrow cells dying, though patient may appear/feel well, then a drop in blood cell counts for several weeks with anorexia, fever, malaise. Death from infection and hemorrhage. Gastrointestinal Syndrome (dose, 10–100 Gy): anorexia, severe nausea, vomiting, cramps, diarrhea followed by bone marrow and GI tract cells dying, though patient may appear/feel well. Then malaise, anorexia, severe diarrhea, fever, dehydration, electrolyte imbalance. Death from infection, dehydration, and electrolyte imbalance. Cardiovascular/CNS Syndrome (dose, >50 gy) extreme nervousness; confusion; severe nausea, vomiting, watery diarrhea; loss of consciousness; burning sensations of the skin then patient may gain partial functionality followed by more watery diarrhea, convulsions, coma and death.	Blood forming cells, gastrointestinal tract, and rapidly dividing cells	Yes IARC	Source in waste and in surface soils

Table 2-3. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
			Cutaneous Radiation Syndrome (<0.7 Gy): damaged basal cell layer of skin inflammation, erythema, and dry or moist desquamation. Hair follicles may be damaged causing epilation. May be followed by transient and inconsistent erythema (with itching). Then, may be a latent phase followed by intense reddening, blistering, and ulceration of the irradiated skin. Very large skin doses can cause permanent hair loss, damaged sebaceous/sweat glands, atrophy, fibrosis, decreased or increased skin pigmentation, and ulceration or necrosis of the exposed tissue. Chronic: Possible cancer.			

a. Sources: *Threshold Limit Values Booklet* (ACGIH 2003) and substance-specific standards (29 CFR 1910).

b. These include (1) nervous system: dizziness, nausea, and lightheadedness; (2) dermis: rashes, itching, and redness; (3) respiratory system: respiratory effects; and (4) eyes: tearing and irritation.

c. If yes, identify agency and appropriate designation (i.e., ACGIH A1 or A2; National Institute of Occupational Safety and Health (OSHA); Occupational Safety and Health Administration (NIOSH); International Agency for Research on Cancer (IARC); National Toxicology Program (NTP).

PEL = permissible exposure limit.
TLV = threshold limit value.
STEL = short-term exposure limit.
CNS = central nervous system.
PCB = polychlorinated biphenyl.

Table 2-4. Summary of OU 3-13, Group 3, Other Surface Soils, remediation activities, associated hazards, and mitigation.

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Mobilization and site preparation (Heavy equipment, motor vehicles, support equipment, site clearing, utility surveys, and establish zones and staging areas)	Radiological contamination—subsurface soils. Radiation exposure— subsurface soils.	Radiological control technician surveys, radiological work permit (RWP) as required, dosimetry, direct-reading instruments, and compliance with posted entry and exit requirements to project areas.
	Nonionizing radiation—Solar UV.	Train workers.
	Noise—multiple running engines, backup alarms.	Industrial hygienist (IH) monitoring and use hearing protective devices as required.
	Chemical and inorganic contaminants—subsurface soil, marking paint, diesel fuel, hydraulic fluid, and oil.	Controlled areas, qualified operators, job safety analyses (JSAs), safe work permits (SWPs), TPRs, or work packages. Material safety data sheets for chemicals onsite, IH monitoring, and PPE.
	Equipment movement and vehicle traffic—trailers, pinch points, ergonomic concerns, and struck-by or caught-between potential.	Train workers, JSAs, SWPs, TPRs, qualified heavy equipment operators, designated traffic lanes and areas, watch body position, and wear PPE.
	Lifting and back strain—moving and staging materials.	Mechanical equipment movement, proper lifting techniques, and two-person lifts. Subcontractor may use the "whichever is less: 50 lb or 1/3 your body weight" rule.
	Heat and cold stress.	IH monitoring and work-rest cycles as required. Cool drinking water available.
	Tripping hazards and working-walking surfaces—existing installations in ground, uneven surfaces, rocks, ice- and snow-covered surfaces, and wet equipment decks and ladders.	Awareness of installation locations, surface conditions, and salt and sand icy areas. Use nonskid or high-fiction footwear on walking surfaces.
	Stored energy sources and subsurface interferences—electrical, water and gas lines, elevated materials, hoisting and rigging, gas cylinders.	Identify and mark all utilities and subsurface structures, identify at-risk surface encumbrances, ensure all lines and cords are checked for damage and continuity, use ground-fault circuit interrupter (GFCI) on outdoor equipment, and comply with minimum clearances for overhead lines. Secure cylinders, caps, and bottles before movement.

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Excavation of contaminated soils or removal of boxed contaminated materials	Radiological contamination—subsurface soils. Radiation exposure—near waste shipments.	Radiological control technician surveys, air monitoring, RWP as required, dosimetry, direct reading instruments, comply with posted entry and exit requirements to project areas.
	Nonionizing radiation—solar UV.	Train workers.
	Noise—multiple running engines, backup alarms.	IH monitoring and use hearing protective devices as required.
	Chemical or inorganic contaminants—subsurface soils, marking paint, diesel fuel, hydraulic fluid, and oil.	Controlled areas, qualified operators, JSAs, SWP, TPRs or work package. Material safety data sheets for chemicals onsite, industrial hygienist monitoring, and PPE.
	Equipment movement and vehicle traffic—pinch points and struck-by and caught-between potential.	Train workers, JSAs, SWPs, TPRs, qualified heavy equipment operators, designated traffic lanes and areas, watch body position, wear PPE.
	Engulfment due to cave-in, hazardous atmosphere potential, fall hazard, and objects falling into excavation.	Competent person on site. Keep excavated materials, tools, supplies, etc. 2 ft back from edge of excavation. Use retaining devices for supplies, etc. staged within 2 ft of excavation. Inspect excavation prior to entry and after any hazard-increasing event. Proper means of access/egress. Proper surface encumbrance support. Erect barricades or barriers or use other means to prevent falls into excavations.
	Lifting and back strain—staging materials and lifting carts.	Proper lifting techniques, two-person lifts (as required). Subcontractor may use the "whichever is less: 50 lb or 1/3 your body weight" rule.
	Heat and cold stress.	IH monitoring and work-rest cycles (as required).
	Tripping hazards and working-walking surfaces—existing installations in ground, uneven surfaces, rocks, ice- and snow-covered surfaces, and wet equipment decks and ladders.	Awareness of installation locations, surface conditions, salt and sand icy areas. Use nonskid or high-friction footwear on walking surfaces.
Loading contaminated soils or materials onto transport.	Radiological contaminants—subsurface soils. Radiation exposure—subsurface soils.	Radiological control technician surveys, dosimetry, continuous air monitoring and periodic grab samples, and hold points as specified in the RWP.
	Nonionizing radiation—solar UV.	Train workers.

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Noise—multiple running engines, backup alarms.	IH monitoring and use hearing protective devices as required.
	Chemical and inorganic contaminants—subsurface soil and waste, marking paint, diesel fuel, hydraulic fluid, and oil.	Material safety data sheets for chemicals onsite, industrial hygienist monitoring, and PPE.
	Equipment movement and vehicle traffic—forklift, crane, pinch points, ergonomic concerns, and struck-by or caught-between potential.	Controlled work areas, qualified operators, JSAs, SWPs, TPRs or work package, proper body position, pre-use and periodic inspections, and PPE.
	Hoisting and rigging.	Trained and qualified riggers. Pre-use and periodic inspections.
	Lifting and back strain—staging and lifting materials.	Proper lifting techniques, two- or three-person lifts (probe casing). Subcontractor may use the "whichever is less: 50 lb or 1/3 your body weight" rule.
	Heat and cold stress.	IH monitoring, work-rest cycles (as required)
	Tripping hazards and working-walking surfaces—existing installations in ground, uneven surfaces, rocks, ice- and snow-covered surfaces, and wet equipment decks and ladders.	Awareness of installation locations, surface conditions, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces. Use nonskid or high-fiction footwear on walking surfaces.
Backfilling excavated areas	Equipment movement and vehicle traffic—pinch points and struck-by and caught-between potential.	Train workers, JSAs, SWPs, TPRs, qualified heavy equipment operators, designated traffic lanes and areas, watch body position, wear PPE.
	Nonionizing radiation—solar UV.	Train workers.
	Noise—multiple running engines, backup alarms.	IH monitoring and use hearing protective devices as required.
	Lifting and back strain—staging and lifting materials.	Proper lifting techniques, two-person lifts (as required). Subcontractor may use the "whichever is less: 50 lb or 1/3 your body weight" rule.
	Heat and cold stress.	IH monitoring and work-rest cycles (as required).
	Tripping hazards and working-walking surfaces—existing installations in ground, uneven surfaces, rocks, ice- and snow-covered surfaces, and wet equipment decks and ladders.	Awareness of installation locations, surface conditions, and salt and sand icy areas. Use nonskid or high-fiction footwear on walking surfaces.

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Demobilization	Radiological contaminants—decontamination of tools and equipment. Radiation exposure—decontamination of tools and equipment.	Radiological control technician surveys, dosimetry, air monitors, hold points.
	Equipment movement and vehicle traffic—pinch points and struck-by and caught-between potential.	Train workers, JSAs, SWPs, TPRs, qualified heavy equipment operators, designated traffic lanes and areas, watch body position, wear PPE.
	Nonionizing radiation—solar UV.	Train workers.
	Noise—multiple running engines, backup alarms.	IH monitoring and use hearing protective devices as required.
	Lifting and back strain—staging and lifting materials.	Proper lifting techniques, two-person lifts (as required).
	Heat and cold stress.	IH monitoring and work-rest cycles (as required).
	Tripping hazards and working-walking surfaces—existing installations in ground, uneven surfaces, rocks, ice- and snow-covered surfaces, and wet equipment decks and ladders.	Awareness of installation locations, surface conditions, salt and sand icy areas. Use nonskid or high-friction footwear on walking surfaces.

2.1.1 Routes of Exposure

Exposure pathways exist for both chemicals and radionuclides at the project site. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards; however, the potential for exposure to contaminants still exists. Exposure pathways include those listed below:

- Inhalation of radiological and nonradiological contaminated soil or fugitive dusts during waste handling, disposal, or decontamination tasks. Inhalable or respirable (dependent on the particle size) fugitive dusts may have trace amounts of radiological or nonradiological contaminants associated with them, resulting in potential respiratory tract deposition.

- Skin absorption and contact with radiological and nonradiological contaminated soil or surfaces during waste handling, disposal, and decontamination tasks. Radiological and nonradiological contaminants can be absorbed through the skin, resulting in uptake through the skin and/or skin contamination.

- Ingestion of radiological and nonradiological contaminated soil or materials adsorbed to dust particles or waste residues, resulting in potential uptake of contaminants through the gastrointestinal (GI) tract that may result in GI irritation, internal tissue irradiation, and/or deposition to target organs.

- Injection of radiological and nonradiological contaminated materials by breaking of the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all project tasks. Where they cannot be eliminated or isolated, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards. Table 2-4 summarizes each primary project task, associated hazards, and mitigation procedures.

The primary hazard identification and mitigation document for OU 3-13, Group 3, Other Surface Soils, Remediation Phase I is the project/activity JSA. Safe work permits (SWPs) and radiological work permits (RWPs) may be used in conjunction with the JSA and this HASP to address specific hazardous operations (e.g., hot work) and radiological conditions at the project site. If used, these permits will further detail specialized PPE and dosimetry requirements.

2.1.2 Chemical Exposure Control

Control measures to prevent or minimize airborne solids are found in Table 3-2 of Section 3 below. It is anticipated that these control measures will be adequate to curtail particulate inhalation and accumulation on work surfaces.

Based on the reported concentrations in Table 2-1 (all below 1 part per million [ppm]) and outside work locations, exposures to the listed chemicals that produce volatile or semivolatile organic compounds (VOCs or SVOCs) are expected to be well below OSHA permissive exposure levels (PELs) or American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs) for the chemicals. Should sustained concentrations of VOCs be encountered, actions specified in Section 3, Table 3-2, below are to be taken.

Note: A sustained concentration is a 1-minute period monitored with an appropriate instrument such as a mini-RAE photo-ionization detector that results in a reading at or above the specified action level.

Further controls are discussed in Section 7 of this HASP.

2.1.3 Radiation Exposure Control

Radiation exposure limits are based on requirements contained in Subpart C of 10 CFR 835 and company policies and procedures. The limits, including administrative control limits, for OU 3-13, Group 3, Other Surface Soils, have been established and will be published in required RWPs. All radiation exposures will be maintained as low as reasonably achievable (ALARA) through selected suitable work controls such as, but not limited to, the following:

- Appropriate level of HAZWOPER and radiological worker training
- RWP, JSA, and other work control documentation
- Controlled and/or amended water sprays to control dust
- Postings
- Hold points
- Worker rotation
- Site access and exit controls.

The OU 3-13, Group 3 project sites will be managed to ensure that (1) acceptable short-term risk levels will be met for members of the community and nonradiation workers, and (2) OSHA and DOE dose limits will not be exceeded for radiation workers.

2.2 Biological, Environmental, and Physical Hazards and Mitigation

Biological, environmental, and physical hazards will be encountered while performing contaminated soils removal and related support tasks at the OU 3-13, Group 3, sites. Section 4.2 provides general safe-work practices that must be followed at all times. The following sections describe specific industrial safety hazards and procedures to be followed to eliminate or minimize potential hazards to project personnel.

2.2.1 Material Handling and Back Strain

Material handling and maneuvering of various pieces of equipment may result in employee injury. All lifting and material-handling tasks will be performed in accordance with PRD-2016/MCP-2739, "Material Handling, Storage, and Disposal." Personnel will not physically lift objects weighing more than 22 kg (50 lb) or 33% of their body weight (whichever is less) alone. Additionally, back strain and ergonomic considerations must be given to material handling and equipment usage. Mechanical and hydraulic lifting devices should be used to move materials whenever possible. The industrial hygienist

will conduct ergonomic evaluations of various project tasks to determine the potential ergonomic hazards and provide recommendations to mitigate these hazards. Applicable requirements from PRD-2016 or MCP-2739, "Material Handling, Storage, and Disposal," also will be followed.

2.2.2 Repetitive Motion and Musculoskeletal Disorders

Long, continuous periods of shoveling, operating a hand compactor, and other repetitive tasks to be performed may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project industrial hygienist will evaluate project tasks and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with PRD-2016/MCP-2739, "Material Handling, Storage, and Disposal."

2.2.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. The OU 3-13, Group 3 sites present inherent tripping hazards because of the nature of excavation work and naturally occurring environmental conditions. Additionally, the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces combined with objects beneath the snow. During the prejob briefing, all personnel will be made aware of tripping hazards that cannot be eliminated. Tripping and slip hazards will be evaluated during the course of the project in accordance with PRD-2005 or PRD-5103, "Walking and Working Surfaces."

2.2.4 Elevated Work Areas

Personnel may sometimes be required to work on elevated equipment or at heights above 1.8 m (6 ft). During such work, employees will comply with requirements from PRD-2002 or PRD-5096, "Fall Protection," and applicable requirements from 29 CFR 1910.178, "Powered Industrial Trucks"; PRD-2003, "Ladders"; PRD-2004 or PRD-5098, "Scaffolding"; and PRD-2005 or PRD-5103. Where required, a fall protection plan will be written.

2.2.5 Powered Equipment and Tools

Powered equipment and tools present potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer's specifications. At no time will safety guards be removed. Requirements from PRD-2015, "Hand and Portable Power Tools," or PRD-5101, "Portable Equipment and Handheld Power Tools," will be followed for all work performed with powered equipment, including hand tools. All tools will be inspected by the user before use.

2.2.6 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as overhead and underground lines associated with OU 3-13, Group 3 operations, may pose shock or electrocution hazards to personnel. Safety-related work practices will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. If work on energized systems is necessary, these practices will conform to the requirements in PRD-2011 or PRD-5099, "Electrical Safety"; MCP-3650, "Chapter IX Level I Lockout and Tagouts"; MCP-3651, "Chapter IX Level II Lockouts and Tagouts"; and Parts I through III of the National Fire Protection Act 70E. In addition, all electrical work will be reviewed and completed under

the appropriate work controls (e.g., TPRs and work orders). When working around overhead lines, clearances will be maintained at all times. Additionally, all underground utilities and installations will be identified before conducting excavation activities in accordance with PRD-2014, "Excavation and Surface Penetrations."

2.2.7 Fire and Flammable Materials Hazards

Fuel will be required for equipment use during OU 3-13, Group 3 operations. Flammable hazards may include the transfer and storage of flammable or combustible liquids in the operations area. Portable fire extinguishers with a minimum rating of 10A/60BC will be strategically located at the project site to combat Class ABC fires. They will be located in all active operations areas, on or near all facility equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. Guidance from MCP-2707, "Compatible Chemical Storage," will be consulted when storing chemicals. Additionally, a fire hazards analysis may be prepared for the project in accordance with MCP-579, "Performing Fire Hazards Analysis."

2.2.7.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. A fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled. Disposal of combustible materials will be assessed at the end of each shift. Class A combustibles such as trash, cardboard, rags, wood, and plastic will be properly disposed of in appropriate waste containers. The fire protection engineer also may conduct periodic site inspections to ensure all fire protection requirements are being met.

2.2.7.2 Flammable and Combustible Liquids. Fuel used at the site for fueling must be safely stored, handled, and used. Only flammable liquid containers approved by the Factory Mutual and Underwriters Laboratories and labeled with the contents will be used to store fuel. All fuel containers will be stored at least 15 m (50 ft) from any facilities and ignition sources or they will be stored inside an approved flammable storage cabinet. Additional requirements are provided in PRD-2201 or PRD-308. Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire.

2.2.7.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from PRD-2010 or PRD-5110 "Welding, Cutting, and Other Hot Work," will be followed whenever these types of activities are conducted.

2.2.8 Pressurized Systems

Pneumatic and hydraulic systems associated with heavy equipment and motor vehicles will be operated at the project site, as may gas welding and cutting torches, and portable pressure washers. The hazards presented to personnel, equipment, facilities or the environment because of inadequately designed or improperly operated pressure (or vacuum) systems include blast effects, shrapnel, fluid jets, release of toxic or asphyxiant materials, contamination, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, vacuum, or compressed gas systems. The requirements of PRD-2009, "Compressed Gases"; PRD-5, "Boilers and Unfired Pressure Vessels"; and the manufacturer's operating and maintenance instructions must be followed.

All pressure systems will be operated in the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. Additionally, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions regarding pressure systems in use at the project site.

2.2.9 Compressed Gases

Gas welding and cutting activities, and environmental sampling may be conducted at OU 3-13, Group 3 soil remediation sites. All cylinders will be used, stored, handled, and labeled in accordance with PRD-2009. Additionally, the safety professional should be consulted about any compressed gas cylinder storage, transport, and usage issues.

2.2.10 Heavy Equipment and Moving Machinery

Hazards associated with the operation of heavy equipment include injury to personnel (e.g., struck-by and caught-between hazards), and equipment and property damage. All heavy equipment will be operated in the manner in which it was intended and in accordance with manufacturer's instructions. Only authorized qualified personnel will be allowed to operate equipment and personnel near operating heavy equipment must maintain visual communication with the operator. Personnel will comply with PRD-2020 or MCP-2745, "Heavy Industrial Vehicles," and PRD-2019 or PRD-5123, "Motor Vehicle Safety."

Personnel working around or near cranes or boom trucks will also comply with PRD-600, "Site Maintenance Management Program," and MCP-1143, "Hoisting and Rigging INTEC Supplement to PRD-160," as applicable and appropriate.

Project personnel working around or near heavy equipment and other moving machinery will comply with the following BBWI documents:

- MCP-6501, "Hoisting and Rigging Operations"
- MCP-6502, "Hoisting and Rigging Maintenance"
- MCP-6503, "Inspection and Testing of Hoisting and Rigging Equipment"
- MCP-6504, "Hoisting and Rigging Lift Determination and Lift Plan Preparation"
- MCP-6505, "Hoisting and Rigging Training"
- DOE-STD-1090-01, Chapter 15, Construction Hoisting and Rigging Equipment Requirements, Department of Energy (DOE).

Additional safe practices will include the following:

- All heavy equipment will have backup alarms.
- Walking directly behind or to the side of heavy equipment without the operator's knowledge is prohibited. All precautions will be taken before moving heavy equipment.

- While operating heavy equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.

- All equipment will be kept out of traffic lanes and access ways and will be stored so as not to endanger personnel at any time.

- All unattended equipment will have appropriate reflectors or be barricaded if left on roadways.

- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.

- The swing radius of heavy equipment will be adequately barricaded or marked to prevent personnel from entering into the swing radius.

2.2.11 Excavation, Surface Penetrations, and Outages

Excavation activities will be conducted to remove contaminated soils from OU 3-13, Group 3 sites. All surface penetrations and related outages will be coordinated through the INTEC construction coordinator and will require submittal of an outage request (i.e., Form 433.1, "Outage Request") for outages (e.g., road, electrical, and water). The submission of an outage request will not be considered an approval to start the work. Other specific outage requirements are addressed in the special conditions section of the management and operating contract. No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation has been documented (subsurface investigation).

All excavation activities will be conducted and monitored in accordance with PRD-2014, PRD-22, "Excavation and Surface Penetrations," and 29 CFR 1926, Subpart P, "Excavations." The following are some key elements from these requirements:

- The location of utility installations (e.g., sewer, telephone, fuel, electric, water lines, or any other underground installations) that may reasonably be expected to be encountered during excavation work will be determined before opening an excavation.

- Structural ramps that are used solely by employees as a means of access or egress from excavations will be designed by a competent person. Structural ramps used for access or egress of equipment will be designed by a competent person qualified in structural design and will be constructed in accordance with the design. Structural ramps will be inspected in accordance with Form 432.57, "Excavation Checklist."

- Employees exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable garments marked with or made of reflecting or high-visibility material.

- Daily inspections of excavations, areas adjacent to the excavations, and protective systems will be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection will be conducted by the competent person before the start of work and as needed throughout the shift. Inspections also will be made after every rainstorm or other hazard-increasing occurrence.

- Sloping or benching will be constructed and maintained in accordance with the requirements set forth in 29 CFR 1926, Subpart B, Appendix B, for the soil type as classified by the competent person. This classification of the soil deposits will be made based on the results of at least one visual inspection and at least one manual analysis.

2.2.12 Hoisting and Rigging

All hoisting and rigging of the boxed waste (if necessary) will be performed in accordance with PRD-2007, "Hoisting and Rigging," or PRD-600, "Site Maintenance Management Program," and DOE-STD-1090-01 "Hoisting and Rigging," as applicable for OU 3-13, Group 3 operations. Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by qualified personnel. Additionally, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation
- Crane hooks and latches for deformation, cracks, and wear
- Hydraulic systems for proper oil level
- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage
- Hoist ropes for kinking, crushing, birdcaging, and corrosion
- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

Note: The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

2.2.13 Overhead Objects

Personnel may be exposed to falling overhead objects, debris, or equipment or impact hazards during waste loading operations. Sources for these hazards will be identified and mitigated in accordance with PRD-2005 or PRD-5103. In the case of overhead impact hazards, they will be marked by using engineering-controls protective systems where there is a potential for falling debris, in combination with head protection PPE.

2.2.14 Personal Protective Equipment

Wearing PPE may reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the work site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with PRD-5121, "Personal Protective Equipment," and MCP-432, "Radiological Personal Protective Equipment." All personnel who wear PPE will be trained in its use and limitations in accordance with PRD-5121.

2.2.15 Decontamination

Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. Additionally, electrical hazards may be present if powered equipment (e.g., a powered pressure washer) is used. Mitigation of these walking-working surfaces and electrical hazards are addressed in other prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with manufacturer's operating instructions, personnel will wear appropriate PPE to prevent high-pressure spray injuries, ground-fault circuit protection will be used, and these tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5.

2.3 Environmental Hazards and Mitigation

Environmental hazards present potential hazards to personnel during project tasks. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states what procedures and work practices will be followed to mitigate them.

2.3.1 Noise

Personnel involved in project activities may be exposed to noise levels from the heavy equipment, motor vehicles, power tools, etc., that exceed 85 decibel A-weighted (dBA) for an 8-hour time-weighted average (TWA) or 83 dBA for 10-hour TWA. The effects of high sound levels (noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear, and pain and temporary or permanent hearing loss
- Interference with communication that would warn of danger.

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with PRD-2108, "Hearing Conservation," or MCP-2719, "Controlling and Monitoring Exposure to Noise," to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8 hours of exposure or 83 dBA for 10-hour exposures).

Personnel whose noise exposure meets or exceeds the allowable TWA will be enrolled in the ICP Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA (83 dBA for a 10-hour TWA) will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the industrial hygienist until directed otherwise. Hearing protection devices will be selected and worn in accordance with PRD-2108 or MCP-2719.

2.3.2 Temperature and Ultraviolet Light Hazards

Project tasks will be conducted during times when there is a potential for heat or cold stress that could present a potential hazard to personnel. The field team leader/subcontractor technical representative (FTL/STR) or job supervisor will be responsible for obtaining meteorological information to determine if additional thermal stress administrative controls are required. All project personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects.

MCP-2704 or PRD-2107, "Heat and Cold Stress," guidelines will be followed when determining work rest schedules or when to halt work activities because of temperature extremes.

2.3.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to unconsciousness, to death. In addition, tasks requiring the use of protective equipment or respiratory protection prevent the body from cooling. Personnel must inform the FTL/STR or HSO when experiencing any signs or symptoms of heat stress or observing a fellow employee (i.e., buddy) experiencing them. Heat stress stay times will be documented on the appropriate work control document(s) (e.g., an SWP, Prejob Briefing Form, or other) by the HSO in conjunction with the IH (as required) when personnel wear PPE that may increase heat body burden. These stay times will take into account the amount of time spent on a task, the nature of the work (i.e., light, moderate, or heavy), type of PPE worn, and ambient work temperatures. Table 2-5 lists heat stress signs and symptoms of exposure.

Table 2-5. Heat stress signs and symptoms of exposure.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; cold, clammy skin; heavy perspiration; total body weakness; dizziness that sometimes leads to unconsciousness	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.
Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; dry, hot skin; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

Note: Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The FTL/STR or designee should immediately request that an ambulance (777 or 526-1515) be dispatched from the Central Facilities Area (CFA) medical facility (CFA-1612), and the individual should be cooled as described above in Table 2-5 based on the nature of the heat stress illness.

2.3.2.2 Low Temperatures and Cold Stress. Personnel will be exposed to low temperatures during fall and winter months or at other times of the year if relatively cool ambient temperatures combined with wet or windy conditions exist. Table 2-6 provides the cold stress work and warm-up schedule if cold stress conditions exist (late fall, winter, early spring).

Additional cold weather hazards may exist from working on snow- or ice-covered surfaces. Slip, fall, and material-handling hazards are increased under these conditions. Every effort must be made to ensure walking surfaces are kept clear of ice. The FTL/STR or HSO should be notified immediately if slip or fall hazards are identified at the project locations.

2.3.2.3 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet light (UV) (i.e., sunlight) when conducting project tasks. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following are mitigative actions to take to minimize UV exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Use a sunscreen with a sun protection factor of at least 15
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

2.3.3 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project site (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold), conditions will be evaluated and a decision made by the HSO with input from other personnel to halt work, employ compensatory measures, or proceed. The FTL/STR and HSO will comply with INEEL MCPs and facility work control documents that specify limits for inclement weather.

2.3.4 Biological Hazards

The INEEL is located in an area that provides habitats for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. The Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, they can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the industrial hygienist will be notified immediately and no attempt will be made to remove or clean the area. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with MCP-2750, "Preventing Hantavirus Infection."

Table 2-6. Cold stress work and warmup schedule.

Air Temperature °F (approximate)	No Noticeable Wind		Wind 5 mph		Wind 10 mph		Wind 15 mph		Wind 20 mph	
	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-15 to -19°	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-20 to -24°	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-25 to -29°	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease	
-30 to -34°	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease			
-35 to -39°	40 minutes	4	30 minutes	5	Nonemergency work should cease					
-40 to -44°	30 minutes	5	Nonemergency work should cease							
-45° and below	Nonemergency work should cease									

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) also may be encountered. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from having direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear, and contact the industrial hygienist or HSO for additional guidance as required.

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of the declivity (areas other than the evaporation ponds).

2.3.5 Confined Spaces

There are no identified confined spaces at OU 3-13, Group 3 project sites. Contact the industrial hygienist if there is any question as to whether a space may meet the definition of a confined space. If entry into a confined space is required, then all requirements of MCP-2749, "Confined Spaces," will be followed.

Note: The competent person for an excavation will stop work and consult the HSO and IH should the atmosphere in the excavation become hazardous.

2.4 Other Work-Site Hazards

Work-site personnel should continually look for potential hazards and immediately inform the FTL/STR or HSO of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with PRD-1004 or MCP-553, "Stop Work Authority," if it is perceived that an imminent safety or health hazard exists, or take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards, and then inform the FTL/STR.

Personnel working at the work site are responsible to use safe-work practices, report unsafe working conditions or acts, and exercise good housekeeping habits with respect to tools, equipment, and waste throughout the course of the project.

2.5 Site Inspections

Project personnel may participate in site inspections during the work control preparation stage (such as the hazard identification and verification walkdowns) and conduct self-assessments or other inspections. Additionally, periodic safety inspections will be performed by the HSO, project manager, or STR in accordance with MCP-3449, "Safety and Health Inspections."

Targeted or required self-assessments may be performed during investigation and sampling operations in accordance with MCP-8, "Self-Assessment Process for Continuous Improvement." All inspections and assessments will be documented and available for review by the FTL/STR. These inspections will be noted in the logbook. Health and safety professionals present at the work site may, at any time, recommend changes in work habits to the FTL/STR. However, all changes that may affect the work control documents must have concurrence from the appropriate project technical representatives and a data analysis report must be prepared when required.

3. EXPOSURE MONITORING AND SAMPLING

A potential for exposure to certain appropriate hazards (radiological, chemical, or physical) exists during project tasks while work proceeds in the proximity of the contaminated soil or material removal activities and may affect all personnel who work in the controlled work area or controlled contamination reduction zone and exclusion zone. Refinement of work control zones (see Section 7), use of engineering and administrative controls, worker training, and wearing PPE provides the mitigation strategy for these hazards. Monitoring and sampling will be used during project tasks to (1) assess the effectiveness of these controls, (2) determine the type of PPE needed for individual tasks, and (3) determine the need for upgrading and downgrading of PPE as described in Section 5. Monitoring will be conducted in and around the active work location(s) as frequently as determined appropriate by the radiological control technician (RCT) and industrial hygienist for their respective fields of expertise.

Table 3-1 lists the tasks and hazards to be monitored, the frequency, and the monitoring instruments. Table 3-2 lists the action levels and associated responses for specific hazards.

3.1 Exposure Limits

Exposure limits identified in Table 3-2 serve as the initial action limits for specific chemical, physical, and radiological hazards. Other chemical or physical hazard action levels are established at one-half of the more stringent published permissible exposure limit (PEL) or threshold limit value (TLV). Project tasks will be continually assessed in accordance with PRD-25, "Activity Level Hazard Identification, Analysis, and Control," and evaluated by Radiological Control (RadCon) and Industrial Hygiene personnel to ensure engineering control effectiveness. Action limits should be adjusted as required based on changing site conditions, exposure mitigation practices, and PPE levels.

3.2 Environmental and Personnel Monitoring

Industrial Hygiene and RadCon personnel will conduct initial, periodic, or continuous monitoring with direct reading instrumentation, will perform contamination surveys, or will conduct full- and partial-period air sampling, as deemed appropriate in accordance with the applicable MCPs, in accordance with OSHA substance-specific standards, and as stated on the RWP. Instrumentation listed in Table 3-1 will be selected based on the site-specific conditions and contaminants associated with project tasks. Radiological control personnel and the industrial hygienist will be responsible for determining the best monitoring techniques for radiological and nonradiological contaminants (respectively). Biological, environmental, and physical hazards will be monitored and mitigated as outlined in Section 2.

3.2.1 Industrial Hygiene Area and Personal Monitoring and Instrument Calibration

The project industrial hygienist will conduct full- and partial-period sampling of airborne contaminants and monitoring of physical agents at a frequency deemed appropriate based on direct-reading instrument readings and changing site conditions. All air sampling will be conducted using applicable National Institute of Occupational Safety and Health (NIOSH), OSHA, or other validated methods. Both personal and area sampling and monitoring may be conducted.

Various direct-reading instruments may be used to determine the presence of nonradiological and other physical agents. The frequency and type of sampling and monitoring will be determined by changing site conditions, direct-reading instrument results, observation, professional judgment, and in accordance with the MCP-153, "Industrial Hygiene Exposure Assessment."

Table 3-1. Tasks and hazards to be monitored and monitoring instruments.[a,b]

Tasks	Hazard(s) to be Monitored	Instrument Category to be Used[c]
Waste loading	Ionizing radiation—alpha, beta, gamma	1
	Radionuclide contamination—alpha, beta, gamma	2
	Chemical constituents—organic vapors, lead, cadmium	3, 4
	Respirable dust—silica (area and personal)	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Waste transportation at site	Ionizing radiation—alpha, beta, gamma	1
	Radionuclide contamination—alpha, beta, gamma	2
	Respirable dust—silica (area)	4,5
Waste excavation	Ionizing radiation—alpha, beta, gamma	1
	Radionuclide contamination—alpha, beta, gamma	2
	Chemical constituents—organic vapors, lead	3, 4
	Respirable dust—silica (area and personal)	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Heavy equipment operations	Respirable dust—silica (area and personal)	4, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
Decontamination of equipment	Radionuclide contamination—alpha, beta, gamma	2
	Chemical constituents—organic vapors, lead, cadmium	3, 4
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8

a. Monitoring and sampling will be conducted as deemed appropriate by project Industrial Hygiene and Radiological Control personnel based on specific tasks and site conditions.
b. Equivalent instrumentation other than those listed may be used.
c. 1 = (Alpha) Count rate—Bicron/NE Electra (DP-6 or AP-5 probe) or equivalent.
Stationary—Eberline RM-25 (HP-380AB or HP-380A probe) or equivalent.
(Beta-gamma) Count rate—Bicron NE/Electra (DP-6, BP-17 probes) or equivalent.
Stationary—Eberline RM-25 (HP-360AB probe) or equivalent.
2 = Continuous air monitor (CAM)—ALPHA 6-A-1 (in-line and radial sample heads, pump, RS-485) or equivalent (as required).
CAM (beta)—AMS-4 (in-line and radial head, pump RS-485) or equivalent (as required).
Grab sampler—SAIC H-810 or equivalent.
3 = (Organic vapor) Direct reading instruments (photoionization detector, flame ionization detector, or infrared detector) detector tubes or grab samples.
(Dust) Direct-reading instrument (miniram).
4 = (Organic vapors and lead) Personal sampling pumps with appropriate media for partial and full period sampling using NIOSH or OSHA-validated methods.
5 = (Silica dust, respirable) NIOSH 7500 or equivalent, personal sampling pump, 10-mm cyclone, full-period sampling.
6 = American National Standards Institute (ANSI) Type S2A sound level meter or ANSI S1.25-1991 dosimeter
(A-weighted scale for time-weighed average dosimetry, C-weighted for impact dominant sound environments).
7 = Observation and ergonomic assessment of activities in accordance with PRD-2016/MCP-2739, "Material Handling, Storage, and Disposal," and ACGIH TLV.
8 = Heat stress—wet-bulb globe temperature, body weight, fluid intake.
Cold stress—ambient air temperature, wind chill charts.

Table 3-2. Action levels and associated responses for OU 3-13, Group 3, hazards.

Contaminant/Agent Monitored	Action Level	Response Taken If Action Levels Are Exceeded
Nuisance particulates (not otherwise classified)	>10 mg/m^3 (inhalable fraction) >3 mg/m^3 (respirable fraction)	Move personnel to upwind position of source and close equipment cab windows and doors. Use wetting or misting methods to minimize dust and particulate matter. IF wetting or misting methods prove ineffective, THEN don respiratory protection[a] (as directed by industrial hygienist).
Lead dust	≥30 $\mu g/m^3$ (29 CFR 1910.1025)	Move personnel to upwind position of source. Use wetting or misting methods to minimize dust and particulate matter during mixing. IF wetting or misting methods prove ineffective, THEN don respiratory protection[a] and institute medical surveillance requirements for exposure to lead.
Cadmium dust	≥2.5 $\mu g/m^3$ (29 CFR 1910.1027)	Move personnel to upwind position of source. Use wetting or misting methods to minimize dust and particulate matter during mixing. IF wetting or misting methods prove ineffective, THEN don respiratory protection[a] and institute medical surveillance requirements for exposure to cadmium.
Silica (respirable fraction)	Greater than or equal to the Occupational Safety and Health Administration permissible exposure limit of $\frac{10\ mg/m^3}{\%silica + 2}$ (29 CFR 1910.1000 [Z3])	Move personnel to upwind position of source. Use wetting or misting methods to minimize dust and particulate matter during mixing. IF wetting or misting methods prove ineffective, THEN don respiratory protection[a] (as directed by industrial hygienist).

Table 3-2. (continued).

Contaminant/Agent Monitored	Action Level	Response Taken If Action Levels Are Exceeded
Organic Vapors	5 ppm sustained. (A sustained concentration is a 1-minute period monitored with an appropriate instrument such as a mini-RAE photo-ionization detector that results in a reading at or above the specified action level.)	Move personnel to upwind position of source. Notify the FTL/STR, HSO, and Industrial Hygienist. The HSO, FLT, Job Supervisor, and IH will formulate a return to work plan. Basic elements of the plan are: 1. The IH will identify the source of the gas or vapors using appropriate PPE and instrumentation 2. Assess the risk and consult ICP management if more information is needed 3. Select and implement control measures 4. Return to work. Document the plan in the FTL logbook.
Hazardous noise levels	<85 decibel A-weighted (dBA) 8-hour time-weighted average (TWA), <83dBA 10-hour TWA	No action.
	85 to 114 dBA	Hearing protection required to attenuate hazard to below 85 dBA 8-hour TWA or 83 dBA for 10-hour TWA (device noise reduction rating [NRR]).
	(a) >115 dBA (b) >140 dBA	(a) Isolate source, evaluate NRR for single device, double protection as needed. (b) Control entry, isolate source, only approved double protection worn.
Radiation field	<5 mrem/hour	No action, no posting required.
	5 to 100 mrem/hour @ 30 cm (10 CFR 835.603.b)	Post as "Radiation Area"—Required items: Radiological Worker (RW) I or II training, radiological work permit (RWP), personal dosimetry.
	>100 mrem to 500 rad @ 100 cm (10 CFR 835.603.b)	Post as "High Radiation Area"—Required items: RW II, RWP, alarming personal dosimetry, dose rate meter, and temporary shielding (as required).

Table 3-2. (continued).

Contaminant/Agent Monitored	Action Level	Response Taken If Action Levels Are Exceeded
Radionuclide contamination	1 to 100 times Radiological Control Manual[b] Table 2-2 values (10 CFR 835.603.d)	Post as "Contamination Area"—Required items: RW II training, personal dosimetry, RWP, don PPE, bioassay submittal (as required).
	>100 times Radiological Control Manual[b] Table 2-2 values (10 CFR 835.603.d)	Post as "High Contamination Area"—Required items: RW II training, personal dosimetry, RWP (with prejob briefing), don PPE, bioassay submittal (as required).
Airborne radioactivity	Concentrations (μCi/cc) >30% of a derived air concentration value (10 CFR 835.603.d)	Post as "Airborne Radioactivity Area"—Required items: RW II training, personal dosimetry, RWP (with prejob briefing), don PPE, bioassay submittal (as required).

a. Level C respiratory protection will consist of a full-face respirator equipped with a high-efficiency particulate air filter cartridge as prescribed by the project Industrial Hygiene and Radiological Control personnel (based on contaminant of concern). See Section 5 for additional Level C requirements.

b. Companywide Manual 15, "Radiation Protection – INEEL Radiological Control" (PRD-183).

All monitoring instruments will be maintained and calibrated in accordance with the manufacturer's recommendations, existing industrial hygiene protocol, and in conformance with the companywide safety and health manuals (Manual 14A and 14B). Direct reading instruments will be calibrated, at a minimum, before daily use and more frequently as determined by the project industrial hygienist. Calibration information, sampling and monitoring data, results from direct-reading instruments, and field observations will be recorded as stated in Section 12.

3.2.2 Area Radiological Monitoring and Instrument Calibration

Area radiological monitoring (radiation and contamination) will be conducted during project tasks to ensure that personnel are given adequate protection from potential radiological exposure. Instruments and sampling methods listed in Table 3-1 may be used by the RCT as deemed appropriate and as required by project or task-specific RWPs. When conducted, monitoring will be performed in accordance with Manual 15B, "Radiation Protection Procedures," and 15C, "Radiological Control Procedures." The data obtained from monitoring will be used by RadCon personnel to evaluate the effectiveness of engineering controls and decontamination methods and procedures, and to alert personnel to potential radiation sources.

Radiological Control personnel will use radiation and contamination detectors and counters listed in Table 3-1, or equivalent instruments, to provide radiological information to personnel. Daily operational and source checks will be performed on all portable survey instruments to ensure they are within the specified baseline calibration limits. Accountable radioactive sources will be maintained in accordance with MCP-137, "Radioactive Source Accountability and Control." All radiological survey and monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommendations and existing RadCon protocol, and in conformance with MCP-93, "Health Physics Instrumentation."

3.2.3 Personnel Radiation Exposure Monitoring

Personal radiation monitoring will be conducted to quantify external radiation exposure and potential for uptakes of radioactive material as stated in the project or task-specific RWP. This may include the use of external dosimetry, surface monitoring, and internal dosimetry methods to ensure that engineering controls, administrative controls, and work practices are effectively mitigating radiological hazards.

3.2.3.1 External Dosimetry. Dosimetry requirements will be based on the radiation exposure potential during project tasks. When dosimetry is required, all personnel who enter the project area will be required to wear personal dosimetry devices, as specified by RadCon personnel and the RWP, and in accordance with Manual 15A, "Radiological Protection Manual" (PRD-183).

When RWPs are required for project tasks, the Radiological Control and Information Management System (RCIMS) will be used to track external radiation exposures to personnel. Individuals are responsible for ensuring all required personal information is provided to RadCon personnel for entry into RCIMS and for logging into RCIMS when electronic dosimeters are used.

3.2.3.2 Internal Dosimetry. The purpose of internal dose monitoring is to demonstrate the effectiveness of contamination control practices and to document the nature and extent of any internal uptakes that may occur. Internal dose evaluation programs will be adequate to demonstrate compliance with 10 CFR 835, "Occupational Radiation Protection." The requirement for whole body counts and bioassays will be based on specific project tasks or activities and will be determined by the radiological engineer. Bioassay requirements will be specified on the RWP and project personnel will be responsible for submitting required bioassay samples upon request.